JUN 25 1928

THE GEOGRAPHICAL JOURNAL

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The
GEOGRAPHICAL JOURNAL

Vol LXXI No 6 R.G.S. *June 1928*

SOME VALLEYS AND GLACIERS IN HUNZA: *A paper read at the Evening Meeting of the Society on 23 January 1928 by*

CAPTAIN C. J. MORRIS
3RD Q.A.O. GURKHA RIFLES

DURING the summer of 1923 I was climbing in Switzerland with Mr. Henry F. Montagnier, a Fellow of our Society, and a prominent member of the Alpine Club. Sitting on the balcony of his chalet one evening, Mr. Montagnier expressed a desire to undertake another journey to the Himalaya—he had already been there some twenty years ago—and asked me if I would accompany him, provided the necessary leave and permits could be obtained. At that time we had an idea, only roughly formulated, of going up to Kashgar by the ordinary Leh route, and returning to India *via* Hunza and Gilgit; but without having arranged anything definite I returned to India in the autumn of that year.

I was in Kashmir during the summer of 1926, and whilst passing through Srinagar, took the opportunity of calling upon Sir Aurel Stein in order to discuss with him our proposed journey. Sir Aurel was most helpful and gave me much useful information about travel in Central Asia. He did not anticipate that we should meet with any particular difficulty, but suggested that the journey proposed was a little dull in view of the fact that we should not leave a perfectly well-known high-road. In the meantime however both Mr. Montagnier and I had sent in our official applications to travel to Kashgar in 1927, and in view of the fact that constant references between the various Government Departments, as well as to China, were necessary, we thought it best to keep to our original plan.

Mr. Montagnier arrived in India towards the end of March and we travelled up to Srinagar together, arriving at that place on the 20th. I had already received permission to travel in Chinese Turkestan, but a few days later my companion found that he could not obtain the necessary passports, though he was accorded permission to travel anywhere in Hunza and the neighbouring British territory. This necessitated a change of plans, and we were a little undecided as to what to do. Fortunately Sir Aurel Stein was again in Srinagar, and at his suggestion we resolved

to travel direct to Hunza as soon as the passes were open, thence to establish a base in the vicinity of the Shingshal pass, or possibly beyond it, and from that place to work forward and try to explore the unknown country between the farthest point east in the main Shaksgam valley reached by Sir Francis Younghusband in 1889, and the most westerly point reached by Major Mason's Shaksgam Expedition in 1926, and thus fill in the small but doubtless highly interesting blank patch on the map. This was not to be, however, for reasons which will be explained later; but I have included in this paper some hints and suggestions which I hope may be of use to some future party intending to explore this region.

We were disappointed at having to make this last-minute alteration to our plans, but the thought of travelling in quite unknown territory compensated us for a great deal. I had long wished to see Hunza and its people; but the journey to Hunza is long and costly, rather beyond the means of the average soldier in India, and it was only due to the kindness and hospitality of Mr. Montagnier, who paid the entire expenses of our expedition, that I was at last enabled to visit this most fascinating country.

We left Srinagar on 12 May 1927 by boat, arriving at Bandipur, on the far side of the Woolar lake, two days later in heavy rain. Here we received news that heavy snow had fallen on the Tragbal, thus delaying our start for a day. Profiting by the experience of the Vissers in 1925, I had decided to employ only porters until we reached the Astor valley, and this arrangement enabled us to go steadily forward without a check. On the night of the 21st we crossed the Burzil pass, heavily coated in snow but in good condition, and with the pass behind us the onward journey was monotonously free from incident. Arrived at Gilgit on May 31 we found that the Political Agent, Major Loch, had made all arrangements for our onward journey, and had also asked the Mir of Hunza to provide us with a corps of specially selected men who would carry our loads when once we left the main valley.

There is still some exploration to be done in Hunza territory, for this reason, that through the main valley of Hunza runs the easiest route to Central Asia, the goal of most travellers that way. Many have passed, but few have thought it worth while to stop and explore. Sir Francis Younghusband was, of course, the pioneer. After him came General Sir George K. Cockerill, who also covered much new ground, and many years later called the attention of Fellows of our Society to the fact that there was still a large unexplored area in this comparatively accessible part of Asia (*G.J.* 60, 2, August 1922). In 1925 the Visser Expedition performed a prodigious amount of work and cleared up the majority of the remaining problems. The story of that expedition is familiar from the recent account in the *Journal* (68, 6, December 1926) and from the charming book written later by Madame Visser ('Among the Karakoram Glaciers,' Visser-Hooft, Arnold 1926).

The main Hunza valley is, of course, well known and has been often

described. It is, however, so impressive and leaves such different impressions on different people that I feel it will not be out of place to describe my own briefly here.

Crossing the river at Gilgit one soon turns north into the Hunza valley. For the first march or so the scenery is not particularly striking, being monotonously barren and rocky, only relieved here and there by patches of cultivation round the infrequent villages. Leaving the little hamlet of Chalt we passed through a series of well-cultivated and prosperous-looking villages, of which the most interesting is undoubtedly Nilt. The fort, of which but little now remains, is on the top of a steep precipice. By climbing above this place under heavy fire, and so gaining command of the fort, the late Colonel (then Lieutenant) Manners-Smith gained the Victoria Cross in the little Hunza campaign of 1891, so admirably described by Knight in his 'Where Three Empires Meet.' Looking up the valley behind Nilt there is a truly wonderful but very foreshortened view of Rakaposhi at close quarters; all the more wonderful from the fact that one suddenly turns a corner and there right before one is this enormous mass of snow and ice.

A few miles higher up the valley closes in somewhat, and at Tashot, where the river is spanned by a modern suspension bridge, we crossed into Hunza territory. The gorge here is very narrow and precipitous, Rakaposhi rising majestically above everything. The valley soon opens out again, and there are many fruit trees and crops in plenty. The path was gay with wild roses and lined with aromatic trees, which gave off a perfume strangely reminiscent of orange blossom. The journey from here on to Baltit was a sheer delight, for every turn in the road brought fresh glimpses, either of Rakaposhi or of the wonderful mountain behind Baltit, Boyo Shubran, of which Boboli Moting, or the "Finger Peak," is the most prominent feature.

A little below Baltit is the village of Aliabad, some 7000 feet above sea-level, and from this place one obtains what I would venture to call one of the finest mountain views in the world, certainly one of the most magnificent in the whole Himalaya. The height of Rakaposhi has been computed at 25,550 feet; Aliabad has an uninterrupted view of some 17,000 or 18,000 feet of snow and ice. As we passed there was hardly a cloud in the sky, and the wonderful array of hanging glaciers and precipitous ice-cliffs gleaming in the brilliant sunlight and rising vertically above the emerald fields of the village was a sight never to be forgotten.

We were now joined by our surveyor, Torabaz Khan, and his servant, whose services had kindly been lent by the Surveyor-General in India. Torabaz had been unable to join us before we left Srinagar and had now reached us by arduous double marches, of which he did not in the least complain.

The Mir had sent ponies to meet us at Aliabad, and the short journey up to Baltit was accomplished with speed and comfort. His picturesque

capital is built round the sides of a rocky knoll, on the top of which stands the ancient castle of the Mirs, dominating the whole valley. The wonderful impression of impregnability and aloofness which the scene leaves upon the mind is heightened by the terrific snow-capped crags which appear to rise almost sheer behind the village. The castle is approached through a veritable rabbit warren of alleys and byways, and one eventually gains access to the principal building by a rickety staircase, its wooden hand-rail smoothed and polished by the rubbing of countless hands. Here are stored all the Mir's treasures: presentation swords, gimcrack clocks, a set of Russian china crudely coloured; on the floor a modern Bokharan carpet; on the walls a varied assortment of pictures, photographs of former Political Officers, oil paintings, and a portrait of a late Archduke of Austria, cheek-by-jowl with a highly coloured advertisement of a well-known patent food. But turn for a moment to the window and here is a panorama which almost defies description. Immediately below are the roofs of the surrounding houses, each with a large square hole in it, the sole means of ventilation in Hunza houses. Behind stretches mile after mile of cultivated land, emerald green just now with the fresh young shoots of the wheat. The village of Aliabad is just visible in the far distance, and Rakaposhi towers over all. Here of old the Mirs of Hunza held their Courts, and the people from the street below did homage to their ruler as he showed himself at the castle window.

The people of Hunza do not know Rakaposhi by that name, but as Dumani, the " Mother of the Clouds." I believe that in early days an officer was touring in the district of Bagrot on the other side of the mountain, and there was given the name Rakaposhi.

We spent some days in Baltit, as beyond that place supplies are not obtainable, and it was necessary to make careful arrangements with the Mir, who agreed to forward our various necessities at stated intervals. During our stay the Mir entertained us to dinner one night with a musical entertainment. First one of the court musicians sang old Persian songs to his own accompaniment on the *Rabab*, a many-stringed instrument not unlike a lute. The one on which he played was said to have been brought from Kabul more than a hundred years ago. Later on the dining-table was removed, we seated ourselves round the walls, and the Mir's orchestra, salaaming as they entered, grouped themselves on the floor. There were five performers: two Saronais (sometimes replaced by two flutes), two tenor drums played with the flat of the hand, and two little drums like miniature tympani, giving different notes and played with slender sticks. I was interested to observe that these last were occasionally tuned by holding them in front of the fire to make the parchment contract. The percussion instruments were out of all proportion to the rest, and whatever melody there may have been was completely drowned by the beating of the drums.

The Malangutti glacier and Dasto Ghil

Looking down the Zardigarban towards Yazghil and Kanjut

I explained our intentions very fully to the Mir, but he himself, although perfectly willing to let us proceed, expressed grave doubt as to the advisability of exploring towards the Shaksgam at this time of the year. In the late spring, usually early in June, the snow on the great mountain ranges of Hunza starts to melt; the main river and all the streams in the numerous side valleys rise quickly and remain unfordable until the approach of the cold weather stops further melting and the rivers fall to their normal winter level. The side streams of Hunza are, for the most part, unbridged, and as the cliffs and crags with which the country abounds are difficult and often impassable, one has frequently to wade a stream fifteen or twenty times in a march. Neglect to consider this most important matter may land one in serious difficulties, for one might enter a valley just before the melting of the snow and find oneself unable to get out again for several months. This has been well brought out by Madame Visser in her book, and I stress it here as it is the principal factor on which successful exploration in Hunza depends.

We left Baltit on June 11, intending to cross into the Shingshal as early as possible. The normal method of getting into that valley is to wade the Hunza river at Pasu and proceed straight up the Shingshal gorge to Dikut, fording the river several times on the way. The snow water had already started to come down when we reached Pasu, and, while we ourselves could doubtless have got up the gorge, it would have been quite impossible to get the laden porters across the now swollen stream. When once the river has closed the gorge there is little intercourse between the peoples of Shingshal and Hunza, but it is still possible to reach the valley by crossing the arduous Karun Pir, a pass 15,932 feet above sea, and by this route we had perforce to proceed.

We camped about four hours' march below the summit. It was bitterly cold and a little snow fell during the night. Leaving early the following morning, we had a steep climb over deep snow, but the cold mountain air was delightfully refreshing after the heat of the valley below. A little before reaching the top of the pass there is a fine view to the left up the Karun glacier, at whose head is a fine peak, Karun Koh (Point 22891), but from this point not very impressive.

A strong wind was blowing when we reached the summit, and soft powdery snow was being whirled in all directions, giving the impression that steam was rising from the ridges. The Shingshal side of the pass was, most unfortunately, deep in cloud, and there was little to be seen of the magnificent array of snowy peaks which must be visible from here on a clear day. We could however look across to the gorge at Pasu, and could also see the Momhil and Lupghar Yaz glaciers, pushing their rather unattractive and dirt-covered snouts into the valley below. It was bitterly cold on top, and we stayed only long enough to take a few photographs. I hurried on, hoping to find some sort of path as soon as we got below the snow-line, but was disappointed to find none. On the

Looking down the Zardigarban towards Yazghil and Kanjut

Shingshal side the whole mountain side is composed of enormous shale slopes, lying at such an angle that they are only just stationary, and one gets down as best one can. We seemed to be traversing these shale slopes for hours, and tired out, reached our camp at Dikut, a small level but uninhabited spot at the junction of the Shingshal and Lupghar Yaz streams, towards the evening.

Above Dikut the Shingshal is impassable for a few miles, as great frowning cliffs and shale slopes thousands of feet high come right down to the very water's edge, and one proceeds, even in mid-winter, when the water is at its lowest, across the Momhil stream and thence over the Unmusar spur. The bridge across the Momhil is quite a test of nerves, for, high above the river, it has no hand-rail and is approached by a narrow path which is little more than a ledge cut in the steep rock face. From here on the road presents no difficulties, but there is an extremely trying climb to the top of the Unmusar spur, whence one looks down to the Shingshal river, thousands of feet below, and away in the background is the range on which is the Karun Pir.

The whole of this region must be one of the most desolate in the world. There is not a sign of vegetation, and a solitary eagle and a few choughs were the only birds. Everything here is grim and desolate, and the general effect of the scenery is depressing in the extreme. There is no colour; only huge rock precipices and great shale slopes, rising up above one as far as the eye can see. Even the glaciers with which this country abounds are dirty and covered with débris, and the giants of the Karakoram, but for which the country could only be described as hideous, seem to lift their heads above this scene of desolation almost in disdain. The valleys themselves are on such a gigantic scale that one does not at first realize to what enormous heights the surrounding snow-peaks rise, and it is only after careful inspection that the huge hanging glaciers and ice-falls on the mountain sides are recognized and proclaim these peaks to be of the first magnitude. In this district one looks in vain for signs of former glaciation, for the friable nature of the shaly hillsides has long since obliterated any traces.

The remainder of the Shingshal valley does not differ from the scenery I have already described. One can hardly call it a pleasant country in which to travel, for there are no paths as we know them, and the day's march consists in traversing endless stony slopes, alternated with occasional scrambles amongst the boulders in the river-bed.

Before reaching Shingshal we camped one night on the edge of the Malangutti glacier. It was a relief to find a spring of clear fresh water and a few stunted willows here. The Malangutti differs from the other glaciers in this region in that it is snowy white and free from débris, but we noticed upon it a few erratic blocks of granite. At present the glacier —which was fully explored by the Vissers in 1925 and found to be 18 miles in length—runs right down to the Shingshal, but it exhibits signs

of retreat. At its head is a very steep ice-fall, and, rising behind, the beautiful peak of Dasto Ghil. In common with the Vissers, I found that General Cockerill's name for this mountain, Malungi Yaz, was unknown to the local people, who speak only of Dasto Ghil, or " The sheep-fold," as it means in the local language. The passage of the glacier presented no difficulty, and I was much amused when our porters removed their foot gear, preferring to cross the ice barefoot.

We arranged to spend several days in Shingshal, as this now appeared to be the most suitable spot in which to establish a base upon which we could draw for our further supplies. While here I managed to collect a great deal of information concerning the manners and customs of the Shingshalis, which differ considerably from those of Hunza.

We had arranged all the details for the onward journey to Shaksgam, and there appeared to be no reason why our labours should not be brought to a successful conclusion. Montagnier and I were sitting out under the trees discussing the various problems which might call for solution when a messenger suddenly arrived from Hunza with an urgent telegram, and we were greatly surprised and disappointed to learn that it ordered us on no account to proceed beyond the Shingshal Pass. I cannot, for obvious reasons, discuss the causes which led to our being stopped, and at the time the important thing was for us to decide what we were going to do. It appeared that the only other piece of unexplored country in this part of the world was the Ghujerab valley, and this had been found impassable by the Vissers. It did not seem very hopeful, but we eventually decided to try the Ghujerab as, even if defeated, we could always return the way we had come.

There is no bridge at Shingshal, but the villagers erected one for us. Stout poles were planted on both sides of the river, and between them a thick rope of plaited yak's hair was stretched. Over this was placed a wooden runner, or inverted U-shaped piece of wood, and, trussed up like fowls, we were hauled across, the first man swimming across with the draw rope. The passage of a river in this fashion is more sensational to the onlooker than to the performer, and in actual fact far less terrifying than crossing by means of a birch-twig bridge. In the former case one simply holds tight and is pulled across, the rope breaking or not as the case may be; while in the latter one has to climb across the horrible swaying erection by one's unaided efforts—a much more difficult proceeding. The passage of ourselves, porters, and kit occupied the best part of a day, and we camped but a short distance away, at the entrance to the Zardigarban valley.

The Zardigarban valley is narrow and very steep. At its head is a little plateau, known as the Zardigarban Pamir, one of the Shingshal grazing grounds. Away to the right was the pass of the same name, across which runs the path, which we should otherwise have taken, leading to the Shingshal Pass and on to the Shaksgam. The Zardigarban here turns

sharply to the left, and it was up this valley that our route now lay. We were surprised to find that the valley was about a quarter of a mile wide. It had a stony and boulder-strewn bed, but was practically devoid of water, in spite of the presence of large ice-fields at its head. During the passage of this valley the path ascends an enormous moraine, the glacier of which must have, at some former period, entirely blocked the valley. From the top of this we obtained a view up the Shekhdalga valley, in which is a small glacier of no particular interest. We descended from the moraine, crossed the Shekhdalga, and proceeded on up the Zardigarban once more. A small torrent was now visible, passable anywhere. The sun was shining brilliantly and the radiation from the boulders in the river-bed became extremely trying. Although we were now well above 15,000 feet I have never experienced the effects of lassitude so much, nor felt such an overwhelming desire to sleep. Nor was I alone in this feeling, for I noticed that it was only with real effort that the party covered the remaining mile or so to our camping-place at Jachfarbask. Here I saw two white-capped redstarts and a solitary chough, the only signs of bird-life all day.

The camp at Jachfarbask was pitched just below the snout of the Boesam glacier, from which small showers of stones were continually falling. We spent two nights in this place, and the temperature never once rose above the freezing-point. The first evening was beautifully clear, with hardly a cloud in the sky, and looking down the valley we had a magnificent view of Yazghil, with one of the Kanjut peaks towering behind. Just before darkness finally descended upon us I saw, silhouetted against the sky-line, a large herd of burhel, but they soon scented us and quickly disappeared with a clatter of falling stones.

It was my idea, whilst at Jachfarbask, to ascend one of the higher ridges in the hope of being able to look down into the Ghujerab and fix some points for our map. With this object in view Torabaz and I, taking only sufficient porters to carry the planetables and cameras, set off to climb a high ridge at the extremity of a long line of fantastic aiguilles, to the west of camp. We toiled laboriously over rocks and shale for the first two hours, and then came to a steep snow-filled gully. From a preliminary study of this place by field glasses I had made up my mind that this was the best means of approaching the ridge, but on closer inspection I considered the snow to be too soft and steep for safety, and we therefore crossed to a ridge of rocks, hoping to gain the col by this means. We were some three hours on the rocks, which were glazed with ice in places. It now commenced to snow and the wind was bitterly cold. After reaching the top of the rocks, not without difficulty, we found ourselves faced with another snow-slope, far more dangerous than the first, on the top of which was a cornice of from 15 to 20 feet thick. This alone would have been sufficient to stop us gaining the ridge, and there was nothing left therefore but to retrace our steps. On the way down it ceased to snow, and the sun came out and dispelled the clouds, which had been gathering all

the morning, for a few minutes. The panorama which now unfolded itself made the day's efforts worth while, for we were about 18,000 feet above sea-level and well above the immediately surrounding country. Away to the south-east a magnificent vista of snowy peaks, which must have comprised most of the giants of the Karakoram, came gradually into view. First Yazghil made its appearance, soon to be dwarfed by the two Kanjut peaks, and others still bigger but many miles away. The whole horizon was one vast world of ice and snow, with glaciers coming down in all directions. I was almost glad when the clouds closed over this scene of wonder, for it would have been hard indeed to turn one's back on such a sight.

From our camp at Jachfarbask to the top of the Boesam Pir Pass took just about two hours. The going was easy but rather dangerous in one place where the path runs beneath a line of large rocks precariously balanced on the top of a small wall of ice. The height of the pass by hypsometer is 15,700. The main Boesam glacier (which flows down the Zardigarban valley) is formed by two small and very steep glaciers which flow from the peaks a little to the west, and unite just beneath the summit of the pass. To the north-east is a large snow-filled basin, formed by two large moraines, in the centre of which is a small glacial lake which was completely frozen over when we passed. We continued down the valley, which is here called the Drui valley (from the fact that it has a lake at its head, *Drui* meaning lake in the Wakhi language), and soon mounted on to a huge moraine, which completely fills the valley for a distance of several miles. Several small glaciers flow down from the lateral valleys, but so torn and tumbled is the whole place, it is almost impossible to trace the course of these glaciers once they push their way into the main valley. On the eastern side of the valley was another small range of fine snow-covered peaks, from which three more small glaciers descended. We now came to the snout of the moraine, and were surprised to note that the river issuing from it was only a few inches deep and fordable anywhere. Some of our porters had passed this spot with the Visser party, and told me that it was only with great difficulty that the party was able to cross this river at all. I must point out that we had now had a succession of cloudy days ever since leaving the Shingshal, which meant that the melting of the snow was held up for the time being. The Shingshal men who were guiding us thought that with a continuance of this weather we should be able to get right down the Ghujerab without undue difficulty.

We camped on a small pamir known as Shakshagin, and here I noted *Primula Stuartii* for the first time. Opposite the camp was a small but very steep glacier which did not quite reach the main valley. The lower Drui shows signs of having been filled with small glaciers at one time, which flowed from the many lateral valleys, the old moraines of which tend to divide the valley into a series of terraces, one above the other,

and between which are now small grassy plateaus, known locally as Pamirs. These pamirs are used by the people of Shingshal as grazing grounds for yaks and sheep. The Shingshalis also graze their flocks as far down the Ghujerab as they can get, but they never enter the Khunjerab, which is grazed only by the people of Gircha and Misgar.

The Drui joins the Ghujerab at Mandi Kushlak, a small collection of stone huts which were however unoccupied at the time. Here we were greatly surprised to find ourselves in a broad stony valley at least three-quarters of a mile wide. To the east we could see the two streams, the Ghidims and the Mai Dur, which uniting form the Ghujerab. At the heads of these two valleys are snowy peaks, which form the watershed between the Hunza and Oprang valleys. Although there are no known passes into the Oprang it seemed to us, from a careful study of the country, that several ways might possibly be found, but this would require the assistance of trained guides, as, although the ridges are not particularly high, a great deal of step cutting would be necessary. We were glad to note that in spite of the enormous ice-fields at the head of the valley the Ghujerab at present consisted of a trifling stream, only a few feet wide, across which one could jump almost anywhere.

A little way down the Ghujerab we mounted on to an enormous moraine, from the top of which we got our first view right down the valley. It looked uninviting; the same bare brown hills, with an occasional snowy peak on either side, and the usual hideous slopes of shale, in colour a monotonous brown. The most conspicuous point in the landscape was Point 21270, a snowy peak just beyond the Chapchingal valley, through which the Vissers entered the Ghujerab. They found themselves unable to get down the Ghujerab, but from the Chapchingal crossed into the Shingshal valley by the route I have just described, but in the reverse direction.

Some few miles down the Ghujerab is joined by another valley to which we gave the name Dih, as this is the name of the little encampment at the junction. Situated at a height of 12,350 feet it is the headquarters of Sadiq, our guide, when he is in the Ghujerab grazing his flocks. He had cultivated the ground round about his little hut and grew enough wheat to support himself and his family during their stay in the valley. Sadiq, who was the only member of our party who knew the lower Ghujerab, was one of the most intrepid and careful cragsmen I have ever seen. Before taking us over a difficult place he would invariably implore us to remove our climbing boots, as he considered them a terrible handicap, which, from the point of view of a Hunza man, who depends almost entirely on balance, they undoubtedly are.

We explored the Dih valley on the day of our arrival and decided to ascend a small peak on the opposite side of the river the following day, in order to fix more points. We left camp at five in the morning, waded through the ice-cold river, and were on the top of our peak by eleven.

There was hardly a cloud in the sky, and we had a fine view of the group of mountains to the south of the Ghujerab, of which Karun Koh was the most prominent on account of its nearness. A little to the west the junction of the Spe Syngo and Ghujerab rivers was visible, and it was at once apparent that if we could force a way up the former we should be rewarded with a magnificent view of Karun Koh at close quarters.

The following day we had the camp moved only a few miles down the valley, and while this was being done Torabaz and I set out to explore up the Spe Syngo. The lower part of this valley is very narrow and precipitous, and but for the fact that there were a large number of enormous boulders in the river-bed, some of them 20 to 30 feet high, which made it possible to cross the torrent here and there, it would have been very difficult to get up the valley at all, as the alternative would have been to traverse a number of difficult rock faces. Even as it was this procedure could not be altogether avoided, and at such times progress became very slow and tedious. About 4 miles from the junction the valley forks, the glacier of Point 20147 coming down the eastern branch, and that of Karun Koh down the western. Near the junction was a small grassy plateau and the remains of a rough stone hut. This place, known as Spe Syngo Wa Dast, is used as a grazing ground in the early spring, when the river has practically no water in it and the passage of the valley presents no difficulty for either man or beast.

One would expect to find, in a valley like the Spe Syngo, traces of glaciation, but there has been so much erosion and the shale slopes are now so huge that any traces have long ago disappeared. For the same reasons it is not now possible to say with certainty whether the valley is U- or V-shaped, but I imagine that this, and in fact all the valleys in this part of the world, must at one time have been filled with ice. So far as we were able to judge, much the greater part of the enormous mass of snow accumulating on the mountains evaporates and does not, as might be expected, melt into the rivers.

We examined the eastern branch of the Spe Syngo first. The glacier is fairly level, uncrevassed, and shows signs of rapid advance. The principal peak at its head, Point 20147, is remarkable chiefly for the enormous number of hanging glaciers on its south-west face. Huge masses of ice thousands of tons in weight, they look as though the least puff of wind would bring them crashing down on to the glacier below. We retraced our steps and prepared to examine the western, and greater, branch of the valley. Just above the junction the valley takes a sharp turn to the west, and consequently Karun Koh, which is situated at its head, is not visible until one has turned the corner. I was prepared to find a view of some grandeur, but not for that which met our eyes. In the foreground an open grassy plain, studded here and there with clumps of *Gentiana carinata*, *Primula Stuartii*, and a brilliant white star-like flower with a splash of red in the centre. Beyond this was the glacier,

sparsely covered with rocks and débris, and again, towering behind all, the magnificent north-eastern face of Karun Koh. From where I stood some 8000 feet of the face of the mountain were visible, and so still was the day, so clear the atmosphere, that every ice-cliff on the mountain side, every glacier and pinnacle of ice, scintillated in the hard clear sunlight as though sculptured in crystal, and from the centre of the glacier below a roaring torrent issued. Slowly a small cloud came up from the west, its shadow travelling gently over the face of the mountain. It rested on one of the pinnacles of the mountain, rose slightly and dissolved in the faint breeze which was now just perceptible. The hoarse cry of a chough, soaring overhead, disturbed my reverie, and I realized that we must return. It is a day such as this that makes all the difficulties of travel, no matter how hard, worth while, and impresses the beauties of nature upon one's mind in such a way that nothing can destroy the memory of them.

The next few marches down the Ghujerab were uneventful and do not merit detailed description here. We came at last to a camping place with the name of Weir Wunak. Immediately below this place the river enters an impassable gorge, the rocks on both sides coming sheer down to the water. It looked at first as though we might be defeated after all, as, even if we ourselves were able to traverse the cliffs, I did not think it would be possible for laden porters. In this matter I sadly misjudged the powers of the men of Hunza, who this day proved themselves to be mountaineers of the very first order. At first we mounted a huge shale slope ; then, crossing an easy rock face, found ourselves about 1000 feet above the river. From here we got our first view of the confluence of the Ghujerab and Khunjerab, and were surprised, and pleased, to note that a very small amount of water was flowing down the latter. We could see our camping place for the night, a small stony plateau about a mile below the junction, but how to get to it was the question ; for separating us was a series of steep earth cliffs which looked impassable and horribly dangerous. Taking the ice-axes, our two Shingshali guides started to hack a way across the cliffs, in which they cut steps in the same way as one does in an ice-slope. For hour after hour we continued thus, and at the worst part of all we halted in order to help the porters across. They disdained our proferred assistance, however, and came over climbing like cats, and with never a murmur at the hardships of this day's work. After nearly twelve hours of incessant exertion we glissaded down the last shale slope, glad on arrival to refresh ourselves with the muddy river water. Montagnier, who has done a great deal of mountaineering, described this as the most extraordinary day's climbing in the whole of his experience.

We had now to cross the river, and in spite of the fact that the last few days had again been cloudy, there was far too much water to make it possible to ford. We had brought with us several hundred feet of rope

Shekhdalga valley and Boesam Pass

Looking down the Upper Zardigarban

Looking back from Unmusar spur towards the Shingshal gorge

Chillinji Pass

Spe Syngo: looking back to the Ghujerab valley

Junction of the Khunjerab and Ghujerab valleys

for use in just such an emergency as this, and finding some drift timber on the bank, proceeded to erect a bridge of the Shingshal pattern. Our cross rope sagged horribly, and we thereupon decided to strengthen it with the guy ropes of all the tents. This did not seem to make very much difference, but in the course of a few hours we got the whole party safely across, and a few days later reached Misgar, in the Hunza valley, without further incident.

On arrival at Misgar we learned that soon after our leaving Shingshal one of the glacier lakes above that place burst and caused heavy floods in the valley. It is interesting to note that such a happening was prophesied by the Vissers when they examined these lakes, though the consequences were not so dire as they predicted.

We spent some days in Misgar, where I developed the whole of the photographs taken up to date. Our intention was to fill in the next week or so by visiting the Kilik and Mintaka passes, and in the meantime I telegraphed to the Survey of India to inquire if there was any further topographical work to be done in the district. We set off for Murkushi on July 17, but on arrival at that place Montagnier was feeling the effects of the climate somewhat and decided to go no farther. Leaving him to return to Misgar I decided to carry out, by means of double stages, a rapid trip to the Pamirs, but the details of this do not come within the scope of this paper, and I accordingly make no mention of them here. I returned to Misgar on July 29 and found a letter from the Survey of India asking us to map the Chapursan valley and explore the Yashkuk and Beskiyenj glaciers. Montagnier was still feeling unwell, and it was therefore decided that he should return to Baltit and await in comparative comfort my return from the Chapursan.

Speaking generally, the scenery of the Chapursan does not differ from that of other parts of Hunza, but the valley is very wide and its stream seems to contribute the bulk of the water flowing into the Hunza river, being much bigger than either the Kilik or Khunjerab streams. There are serviceable paths on both sides of the valley, which, unlike the Ghujerab and Shingshal, is never cut off from the rest of Hunza by the rising of the river.

Some 5 miles upstream we came to what has up to date been known as the Rishipjerab valley. Rishipjerab is the name given to the small pasturage at the entrance to the valley, the valley itself being known as the Kundil. Here are the remains of an old fort and some stone emplacements, built at the time of the Hunza war to withstand a possible advance down the Chapursan valley. The Kundil valley is used as a grazing ground, is easy of access, and presents no features of particular interest. A mile or so farther on we came to the village of Raminji, at the entrance to the Lupghar, another small valley used as an occasional grazing ground.

The Chapursan produces the best crops in the whole of Hunza. There

is still a great deal of good ground not under cultivation, but the present Mir, with his usual forethought, is taking steps to establish new villages at various points in the valley and thus bring this valuable land gradually under the plough. The people of the Chapursan are, for the most part, Wakhis. Most of them came into Hunza territory many generations ago, but of late years there seems to have been a small but steady flow of settlers from Wakhan.

A few miles below Yashkuk I was surprised to notice that the whole valley was filled with earth mounds, some of them 15 to 20 feet high, with rocks and débris embedded in them, the whole covered with a thick layer of light grey mud. This formation extended nearly as far down the valley as Reshit, a distance of several miles. It is accounted for by the local people in the following legend, and on my return to Baltit the Mir also gave me the same story :

About a hundred years ago Yashkuk, of which no trace now remains, was the largest and most important village in Hunza. The people, though prosperous, were very much under the influence of a malignant demon, who had his abode in the mountains at the head of the Yashkuk glacier, This demon could be appeased only by the daily offering of a human sacrifice, and accordingly some member of the village was daily selected to offer himself as sustenance for the monster. At this time the people of Yashkuk were much given to evil living, but the demon took no notice of this provided he obtained his daily sacrifice.

One day an elderly saint, Baba Ghundi by name, appeared on the scene. He remonstrated with the people and offered to protect them against the demon if they would reform their ways. He soon went on his way, telling the people that he would reappear if called upon by name. For a time all went well, until the people, tired of living an orderly life, gradually resumed their old way, and the Demon of Yashkuk again reappeared. Baba Ghundi was called upon to help, and shortly re-appeared. He put matters right once more, but solemnly warned the villagers that if they again returned to their evil ways he would destroy their village and all its inhabitants. He again went on his way, and for a time peace reigned in the village. A few years later, however, the teaching of Baba Ghundi was forgotten and his prophecy of destruction duly came about, for without any warning a huge wave swept down the Yashkuk and completely destroyed the village. Every one was drowned with the exception of one woman, who had refused to participate in the horrible orgies of the villagers, and she is considered to be the original ancestor of the present inhabitants of the Chapursan valley.

There is now no village of Yashkuk, but the place of this name is a large grassy plateau at the junction of the two rivers. It affords perhaps the best grazing in the whole of Hunza and is reserved by the Mir for the use of his own flocks. I was interested to find the cause of the " wave "

which destroyed Yashkuk about a hundred years ago, and accordingly set out to explore the glacier.

About 3 miles above the junction the Yashkuk valley divides into two, and I explored the eastern branch first. This valley, the Kuk-ki Jerab, contains a large glacier which descends from Point 22751, a mountain which is partly responsible for the Batura glacier, that does not flow into the Yashkuk, and is now quite separate from it, although the two glaciers have at some former time been united. As soon as we entered the Kuk-ki Jerab the reason for the débris and mud in the Chapursan was at once apparent, for it was quite obvious that at one time a very large glacier lake existed there. I imagine that the Yashkuk was once much longer than it is at present, and extended past the entrance to the Kuk-ki Jerab, forming an effective outer barrier for the lake. At the same time a large amount of water must have been flowing out of the Kuk-ki, for the glacier is of no mean proportions, and being unable to escape by reason of the dam formed by the Yashkuk, made a lake, until the pressure finally became too great and the barrier gave way. An enormous volume of water and débris swept down the valley into the Chapursan, destroying the village in its course, and leaving a covering of mud which is still visible.

Towards the head of the Kuk-ki Jerab an easy pass leads into the Lupghar valley, and below this pass, on the Kuk-ki Jerab side, is excellent grazing ground which is in regular use during the summer months. A shepherd accompanied us part of the way, and it was a novel sight to see a flock of goats being driven up a glacier, a proceeding which they did not appear to mind in the least.

We retraced our steps, crossed below the snout of the glacier, and re-entered the Yashkuk, keeping to the hillside as it afforded better going than the very tumbled moraine. The Yashkuk is covered in débris and huge boulders, mostly of grey granite, nearly to its source, the peaks at the head being unimportant and of no particular height or beauty. The glacier is crossable anywhere, but it was an arduous performance to pick one's way over the heaps of loose débris and boulders which tended to move as soon as any weight was placed upon them. Although not more than 1½ miles wide it was over three hours before we landed safely on the far side. Here there was a little scrub-covered valley between the moraine and the hillside, and this too was in use as a grazing ground. From here a little track ran down to the main Chapursan valley, and we were enabled to regain our path and reach camp at Ziarat with comparative ease.

Ziarat—at one time called Baba Ghundi—is considered one of the most holy places in the whole of Hunza, for here is the shrine of Baba Ghundi, of whom we have already heard. Ghundi is the name of a place in Bokhara from whence Baba—"the venerable one"—is said originally to have come. There is a similar shrine at Ghundi which is also believed to contain the remains of the saint. This has led to a certain amount of

trouble between the people of the two places in the past, but the Hunzakuts themselves have no doubt in their own minds that theirs is the real shrine, as the following legend, told me by the Mir, goes to prove :

Baba Ghundi died and was buried at Ziarat, in the Chapursan valley, where a shrine was erected over his grave by an ancestor of the present Mir of Hunza. The people of Ghundi, as he was a native of that place, wished to remove the remains of the saint and bury them in his birth-place, but this was not allowed by the people of Hunza. The Ghundi people therefore sent a party over to Hunza with instructions to steal at least some part of the saint's remains. Arrived at Ziarat, they removed the head from the tomb and were preparing to return with it when they found they had all become lame. This lameness enabled the people of Ziarat to catch up with them, which they quickly did, and on the head being returned to the tomb the lameness disappeared.

The tomb is now credited with miraculous powers, and I noticed that it was covered with votive offerings to which my porters added their share.

A few miles above Ziarat the big Besk-i-yenj glacier completely fills the valley, a tumbled mass of snow and ice. It rises on the slopes of Point 21907, on the south of which is the at present unexplored Toltar glacier. The Besk-i-yenj glacier is some 9 miles long and appears to be advancing rapidly. It is joined by a number of small glaciers which come down from the surrounding side valleys. The small Buattar stream, over the pass at the head of which runs a track into Afghan territory, has forced itself between the hillside and the northern edge of the glacier, thus providing the curious spectacle of a river and a glacier running side by side. Towards the end of the glacier the ice becomes too thick for the river to dislodge, and here it disappears beneath the ice to reissue from the snout below. One further valley needs to be mentioned, the Irshad. This also joins the Chapursan at Besk-i-yenj, and at its head is a pass, the one in most general use, leading into Afghanistan.

The Bask-i-yenj is the true source of the Chapursan, and the valley above, that is to the west of, this place, through which runs the insignificant Buattar stream, should rightly be known as the Buattar valley, which is the name by which it is known by the local people. Before entering the main valley the Besk-i-yenj glacier turns sharply to the east, thus forming a barrier right across the Buattar valley. I saw in this place a number of unattended ponies and cows, for whom their owners apparently felt no anxiety. With the big glacier to their east, and the small but steep Buattar glacier to their west, and precipitous hillsides north and south of them, escape was impossible, and they were able to graze in perfect safety until such time as their owners saw fit to fetch them away.

Buattar was a delightful little place, covered with rich grass and bright with a mass of purple geraniums. Sitting outside my tent I saw a diminutive mouse-hare, but it was impossible to see if it differed from the Tibetan variety. Above Buattar a track runs up to the Chillinji pass,

which is 17,000 feet above the sea, and leads into the Karambar valley, but is seldom used, as although perfectly practicable it is rather difficult and arduous. We did not go up the glacier, but ascended a small rock peak from which we could see the summit of the pass, but owing to the approach of bad weather it was impossible to see any great distance.

While I was examining the various glaciers Torabaz was working steadily at the map. As rations were now running short, and there was still a certain amount of local detail to be filled in, we decided that he should remain and finish this work while I returned to arrange the forwarding of further supplies. I got back to Baltit within a week, and found Montagnier awaiting me. He had had rather an uncomfortable time owing to the heat, which at this time of the year, August, is intense during the daytime, in spite of the height of the Hunza valley. We stayed only long enough to settle our affairs and to pay our farewell respects to the Mir, but for whose excellent arrangements and personal kindness and hospitality the traveller in Hunza would indeed fare badly.

I cannot close this brief account without a word of praise for our most excellent porters. These men were with us for just over two months. During this time they were almost continuously on the move and over what is probably some of the worst country in the world for laden men. Always ready to turn their hand to anything, they were, I think, the most cheerful and willing set of men with whom I have ever travelled. One has heard many tales of the trouble given by Himalayan porters in the past to travellers previously unacquainted with the country, and Hunza has been particularly unfortunate in this respect. In order to avoid further happenings of the sort might I too suggest, as General Bruce, Sir Francis Younghusband, Col. Norton and many others have, that future travellers should take the trouble to learn at least the elements of some language intelligible to their men? This is by no means an insuperable difficulty, for a working knowledge of most Himalayan languages can be acquired in a very few weeks (but excluding Burushuski, the mother-tongue of the Hunza people, who mostly understood enough Hindustani for all practical purposes), and I can promise that the result of so doing will repay the traveller many times over, for the people of the Himalaya, like most others for that matter, work best for the man who takes a personal interest in their welfare, and this, no matter what trouble the traveller may take, is hardly apparent to them when their employer does not speak their tongue.

Some Geographical Conclusions, Notes on the Possibility of reaching the Shaksgam from Hunza, and a List of Place Names

Any one contemplating exploration in Hunza during the summer months should remember that the snowfall during the winter of 1926 was exceptionally heavy. This made it possible to work in the valleys during 1927 up to a much later date than would normally be possible.

Major Mason (*G.J.* 69, 4, April 1927) considers that for an attempt to reach

the Shaksgam viâ Hunza, the best plan would be to winter in Gilgit and set off from that place in the very early spring, returning before the snow started to melt, that is, by early June in a normal year. I am in entire agreement with this idea, and the Mir informed me that there would be no difficulty in finding porters at this season, as the fields have all been sown and the men are free.

The Shingshal route is passable for yaks during the winter, and I think the Mir, by previous arrangement, would arrange to send forward, I would suggest to Shingshal Aghzi, the bulk of the party's stores and porters' rations before the arrival of the main party. Shingshal Aghzi is a particularly suitable place in which to establish a base, as it is a convenient spot from which to work in either direction, *i.e.* either towards the Shaksgam or towards Central Asia.

No supplies of any kind whatsoever are obtainable beyond Shingshal, but mutton and milk can be procured from the grazing grounds in the vicinity of the Shingshal Pass during the summer months at such times as the flocks are there for grazing.

If the party is prepared to sacrifice a certain amount of kit it should be possible to work in this region during the summer, but they should take a light steel rope and tackle with which to make a " bridge " if necessary.

Judging by our experience in the Ghujerab, and allowing for the fact that 1927 was an exceptional year, I do not think an active party need ever fear being completely cut off by the rising of the rivers, always provided that they have plenty of time, rations, and a good supply of ropes, and are prepared for hard work; but the late winter and early spring are undoubtedly the best times.

A future party should bring plenty of empty sacks for porters' rations. The local bags of goatskin are expensive and do not last, and the people do not like parting with them.

With regard to the Ghujerab, I think the passage of this valley in a normal year would be impossible after mid-June, and it should be remembered that even in midwinter, when the water is at its lowest, it is not possible to get along the gorge just above the Khunjerab junction, and this part of the journey can only be accomplished by the somewhat hazardous traverse of the cliffs above the river. It seems that this gorge would account for the fact that the Ghujerab is used as a grazing ground by the Shingshalis and not, as would otherwise be the case, by the people of Misgar and Gircha, who as it is graze their flocks in the Khunjerab, the passage of which, at suitable seasons, does not present any difficulty.

The upper Ghujerab is wide and open and a number of flowers and small shrubs are found there. Lower down, the valley gradually narrows and the hillsides are steep and covered with slopes of shale. It is obvious that there are frequent avalanches of rock and shale on a big scale, and these, I think, would account for the absence of vegetation in the lower part of the valley, for even when a few stunted bushes or plants do manage to exist, the chances are that after a few months they are swept away in the train of some avalanche.

All the glaciers in the Ghujerab are on the south side of the valley, *i.e.* they flow from the northern faces of the mountains, and, as far as we could see, there do not appear to have ever been any glaciers flowing down the lateral valleys on the north side of the Ghujerab.

The area round about Mandi Kushlak, *i.e.* at the junction of the Drui and the Ghujerab, appears to have been at one time a large lake, of which traces still remain in the valley floor. A little below this place an old moraine nearly blocks the valley, and at one time probably did so completely. This may have caused the lake.

The area was mapped by Torabaz with the planetable, adjusted to the fixed points of the Survey of India Triangulation of 1913, and in continuation of the topographical work carried out by the Visser Expedition in 1925. Mostly on a scale of 2 miles to 1 inch, it covers a total area of some 900 square miles. (See the Folding Map following page 612.)

With regard to the place-names on the map I would ask future travellers especially to note that with few exceptions, such as large villages like Shingshal, for instance, the names do not denote villages but merely camping places known to the local inhabitants at the time. They are all names of natural objects, *i.e.* "the lonely willow tree," "the red rock," etc., etc., and in later years a future traveller, if using our map, must be prepared to find that some of the places named may be unheard of, for an avalanche may have removed "the lonely willow," and "the red rock" may have long since disappeared in the river.

Place Names in Hunza. W.: Wakhi; T.: Turki

Aghzi (*W.*)	Junction of rivers.
Bandasar (*W.*)	Defile.
Boesam (*W.*)	Roof.
Bulak (*T.*)	Spring of water.
Dasto ghil (*W.*)	Sheep-fold.
Dewan (*W.*)	Pass.
Dikut (*W.*)	Bridge.
Duplaksh (*W.*)	Certain kind of grass.
Dur (*W.*)	Valley.
Ghujerab (*W.*)	*Ghu*, narrow; *Jerab*, a bad place (?).
Jachfarbask (*W.*)	*Jachfar*, the name of a man; *bask*, fallen; hence the place where Jachfar fell.
Jilga (*W.* & *T.*)	Valley.
Kara (*T.*)	Black.
Khunjerab (*W.*)	*Khun*, blood; *Jerab*, see above, from the story that a man once fell into the river and hurt himself, and his blood flowed down the valley.
Koram (*T.*)	Jagged rocks (the more usual translation of this word as gravel was not known).
Malungutti (*W.*)	The middle glacier.
Phurzin (*W.*)	*Phurz*, a birch tree; *-in*, the place of.
Pir (*W.* & *T.*)	Pass.
Shakshagin (*W.*)	Another name for a willow.
Shalghakin (*W.*)	Name of a certain plant.
Shingshal	Unknown by local people, but Mir told me it was the name of the first man to settle in the valley.
Spe syngo (*W.*)	*Spe*, white; *syngo*, any place beside a river.
Tipeskin (*W.*)	Aromatic plant.
Wada khun (*W.*)	*Wada*, mint; *khun*, roof of a house.
Yaz ghil (*W.* & *T.*)	*Yaz*, snow or ice; *ghil* (contracted form), sheep-fold.
Ziarat (*W.* & *T.*)	A shrine.

DISCUSSION

Before the paper the PRESIDENT (Col. Sir CHARLES CLOSE) said: Capt. Morris is well known to the Society as a traveller, explorer, and climber. He was a member of the Mount Everest Expedition of 1922; he is well known to those who are interested in Nepal as having done a good deal of original work

in that country. On this last journey he went into Hunza principally to close up some gaps in our geography: one left by the Vissers' expedition, and one in the Shaksgam. Circumstances beyond his control forbade the second; but he and the surveyor Torabaz Khan between them have done a most excellent piece of work covering about 900 square miles. With those few words I will ask Capt. Morris to commence his lecture.

Capt. Morris then read the paper printed above, and a discussion followed.

Sir FRANCIS YOUNGHUSBAND: I should like to say what a treat it has been to me, and I am sure to you also, to see the beautiful photographs which Capt. Morris has taken of the very remarkable country through which he has just been travelling. We are much indebted both to him for his photographs and interesting description of the country and to Mr. Montagnier for having organized the whole expedition. Listening to the lecture and seeing the slides, I had a certain feeling of regret that it was not one of the officers of the Gilgit garrison who had undertaken this expedition. We have had two lectures, the one by Mr. Visser and the other by Capt. Morris, on expeditions to the Shingshal organized from outside. But it is a matter of surprise that the officers of the Gilgit Agency have not done what General Cockerill did more than thirty years ago, and that is explore the Shingshal valley.

The Hunza region is one of the most remarkable countries in the world. We have seen from the photographs what wonderful mountains there are. And undoubtedly if Capt. Morris had had time and had been there at the right season of the year, which I do not think he was—September and October, or even November, is a better season—he might have obtained still finer photographs of Rakaposhi and other magnificent peaks. What one would hope is that some enterprising officer of the Gilgit Agency would take up this work of exploring Hunza as his special interest, and with those fine Hunza men, of whom we have heard so much from Capt. Morris, make a regular exploration of the different valleys, cross over from one into the other, find out every way by which the valleys can be reached from each other in the different seasons of the year, as Lieut. Cockerill, as he then was, did in 1891 or 1892. Little has been done since then by the officers of the Gilgit Agency. But some of them might when exploring the valleys ascend the mountain sides at different points to see where it is possible to get the best views of Rakaposhi, or right over towards the Karakoram range, possibly even to K_2, so that those photographers who are not particularly good climbers might have information as to where the best views can be obtained. And perhaps later it may be our good fortune to have up there a painter, such as Col. Tanner of the Indian Survey, who could really paint those mountains.

I should like to endorse everything that Capt. Morris has said about the wonderful Hunza men, their hardihood and their enterprise. An officer in charge of the Hunza Scouts might well use those men for his explorations. He would not find it necessary to take tents, for these Hunza men in my time used to raid through the Shingshal valley and over the mountains on to the Leh route without any tents, and I had none myself in 1887. An officer going with these men and calling upon the people of the country as little as possible for transport could do work of great value to this Society.

I would also express my great satisfaction at hearing of the help and support given to Capt. Morris and Mr. Montagnier's expedition by the Mir of Hunza, whom I first knew in the year 1889, when I went through the country. He was half-brother to the then chief. I was present, and I think General Cockerill

was also, at his installation as Mir of Hunza in that picturesque capital of his in the year 1892. He has ever since remained a loyal supporter of the British Government, and I am sure this Society is indebted to him for the support which he has given to the present expedition. I hope it may be our good fortune that Capt. Morris himself will return in some official capacity to that country, perhaps in charge of the Hunza Scouts, and that he will again lecture to us and show us still more beautiful photographs.

General Sir GEORGE K. COCKERILL: To me the photographs we have seen to-night are as though I had had the opportunity of re-visiting these valleys in company with the lecturer. I think Capt. Morris has passed rather lightly over difficulties which must have been obvious to you all. Not merely are the physical difficulties of the country great. It must have occurred to you what excellent capacity for organization Mr. Montagnier and Capt. Morris possess to have organized the expedition and carried it through in the way they did without a hitch. It is not an easy matter to get numbers of men together to carry loads in a sparsely populated country such as Hunza, and to keep them happy and contented. The new country which Capt. Morris has traversed is partly to the east and partly to the west of the main Hunza valley. In the Ghujerab valley, which he first visited, he has mapped, I should say, quite 400 or 500 square miles of country which has hitherto never been visited by a white man, and added a great deal to our knowledge of the upper Chapursan valley by his exploration of the Yashkuk and other tributary valleys. The Chapursan valley has of course been visited before, not only by the Mir of Hunza in the manner the lecturer described, but by Europeans. I was there myself in 1893. I think the Mir came across the Chillinji pass either just before or just after my visit, and, a few years later, Sir Aurel Stein crossed from the Ishkuman valley and descended the Chapursan valley to its junction with the Hunza river. Those who have been through the Chapursan valley before have had other fish to fry, and passed through the valley as quickly as possible in order not to lose the opportunity of completing the task in hand. My own object when I went through it was to visit the Chillinji pass at its head, and also to visit the Irshad pass, which had never before been seen, I think, by a European. We have been told this evening how few people visit this part of the world, but by the number present here to-night one might almost think that the Hunza valley was Piccadilly. I went to the Shingshal valley with the very definite object of completing a link with Sir Francis Younghusband's work. He had come down from the north-east and reached the Shingshal pass. With the object of obtaining more complete knowledge of the various passes, he had then turned back deliberately, made a circular route to the north, and come south again to visit the other passes leading from the Pamir into Hunza. It was under his ægis and on his initiative that all my work was done. My first task was to complete the link between the Hunza valley and the Shingshal pass. So well has that difficult valley since been explored by the Vissers—whose absence to-night we all regret—and by the lecturer that I believe there are only two little portions, the gorge of the Shingshal near Pasu and the gorge of the Tang river between the Shingshal valley and the Shingshal pass which still remain to me as my own preserve. The rest of the valley which I passed through rapidly and of which I made an incomplete survey has been visited since by others who have returned with remarkable photographs and, what is perhaps better still, with very accurate and complete maps.

You saw to-night some beautiful pictures of a double-headed mountain which the lecturer called Dasto Ghil. It was discovered by me in 1892. I

could not measure its height, but I wrote of it at the time that "for grandeur of form and prominence of position there is no feature in the whole Shingshal valley more striking than this magnificent mountain." Subsequently it was measured by the triangulators of the Indo-Russian Link, and it proved to be, not as it has been shown in some of the Society's maps, 25,668 feet in height, but, as is shown in the records of the Survey of India, 200 feet higher, namely 25,868 feet. It is the highest peak of the Karakoram west of K_2. The name that I gave to it and that by which the men with me spoke of it was Malungutti Yaz. Malungutti is a little grazing-ground near the "snout" of the Malungutti glacier. Malungutti means "middle glacier," and "Yaz" is the ordinary word for glacier ice or *névé*. The name given to me obviously meant "the ice or ice-peak of Malungutti." A little higher up the glacier there is another grazing-ground with a sheep-fold. This is marked on the Vissers' map and is called Dasto Ghil. It may well be that I was misinformed and that the mountain takes its name from the higher grazing-ground. In any case, you will agree with me that Dasto Ghil is a more convenient and more beautiful name than Malungutti Yaz. I hope therefore that it may be accepted in future, if only out of compliment to the Vissers, who brought back the first photographs of this mountain and were the first to explore the glacier.

May I, in conclusion, thank the lecturer for his most interesting lecture and congratulate him on the results of his organization and initiative, hoping, with Sir Francis Younghusband, that others, including some from the Gilgit garrison itself, will be tempted to follow in Capt. Morris' tracks.

Col. LORIMER: I am that unfortunate thing, an ex-officer of the Gilgit garrison! After that, although I did intend to say something, I do not think you will expect very much from me. Nevertheless, I must first express my personal thanks to the lecturer for the most interesting account of his travels and observations in a country which I have partially seen and in which, at any rate, I am very much interested now, at a distance. Secondly, I wish to dispel any hope you may be entertaining that I am going to add to your geographical enlightenment. I am no geographer, but modern geography, as I understand it, regards nothing as alien, much less as common or unclean, which has any concern with the Earth or with life on the Earth, so I may be permitted to follow the lecturer and enlarge upon one or two of the less directly geographical, perhaps more humanistic, points on which he touched.

He introduced you to the great Baba Ghundi, much the most important person who has ever visited, travelled, or lived in the Chapursan valley. The story is told in different forms, and I happen to have another version. According to this story at Ishkuk there was a large population which was much harassed by a dragon that did not live in the distant mountain but occupied a pond in the midst of the people, who had to provide the dragon every day with one male yak, 40 to 60 lbs. of ghee, and one human being. One day a husband informed his wife that his turn had come. The wife very dutifully offered to go instead, but they had a perfect treasure of a daughter, who at once said, "No, I will go, and then you will be able to raise up other children in my place." So she took a male yak and a lump of ghee, and went off weeping. On the way she met a stately figure riding on a horse, clad in green, and carrying a lance. She salaamed to him, and he asked her where she was going. She wept again and explained about the dragon. He said, "I am going to lie down and have a little sleep; just you sit by me and look through my beard." The girl sat by him and searched accordingly, and later heard the dragon beginning to stir. She once more gave way to female weakness and shed a tear which alighted on

the old man's face. He woke up with a start and said, "What's the matter now?" "The dragon is getting busy, sir." "Oh, don't you worry," said the old gentleman, and drew his sword, cut the dragon into pieces and strewed the ground with them. The girl went home to her people, and when they saw her coming safely back, perhaps with a natural revulsion of feeling, they were fearfully angry and said, "If you could not command the courage to go through with it you ought never to have gone." She explained that she had not come back through want of courage, but they would not believe her when she told the story of what had happened. So she showed them the pieces of the dragon, and they went and passed on the good news to the rest of the people. They also had to be shown the pieces before they would believe that the dragon had really been disposed of. That night all the inhabitants had a dream, in which Baba Ghundi appeared to them and said, "I am the person who slew the dragon. If any difficulty comes upon you, just let me know. My name is Baba Ghundi." When they woke up the people said, "We had better see if there is anything in this," and they started lamenting and howling. Presently Baba Ghundi came riding down the whole length of the Chapursan, but finding that there was nothing really the matter, he said, "There is some mistake," and disappeared again. This rather amused the people, and they thought they would try again, so they went through the same performance with the same result. Then they tried a third time, and this time Baba Ghundi appeared as a rather disreputable old man. Apparently they knew him, but they stoned him and threw mud at him. He cursed them and went off to the hut of an old woman who was rather different from the others. All she possessed in the world was one sheep giving milk; she rushed out, milked the sheep, and presented Baba Ghundi with the milk. He blessed her and said, "To-morrow something is going to happen. Don't leave your house; get up on to the roof, and if you have lent anything to your neighbours get it back." The old lady followed his instructions. Right enough next morning down came an immense mud flood with old Baba Ghundi riding on the top of it, and it wiped out the whole population with the exception of the little lady sitting on her roof. It spared her, her house, and her land. But she had neglected one sieve which she saw floating down on the top of the flood. She whistled to Baba Ghundi, and he fished the sieve out with his spear and handed it back—a very courteous knight. I understand that the house of the old lady still remains, as a proof of which there is the name Kampire Dior, "Kampir" meaning "old woman" and "dior" "house."

The lecturer stressed the importance to the explorer of a knowledge of the local language, and I think every one who has travelled will endorse his remarks. But when he went on to say that it was possible to get a good working knowledge of a Himalayan language in a few weeks, the duller of us may be allowed to indulge in a little envy. I think perhaps he did not mean to include the Burushaski language of Hunza, which has about twenty or thirty separate forms for the plural, four genders, which affect the verbs as well as nouns, pronouns and adjectives, and many other interesting but rather deterrent phenomena. They have sufficed to occupy my leisure for the last three or four years.

General BRUCE: I do not want to talk about geography, but about the Hunza people. When I first went up there I had a smattering of Hindustani and Punjabi, and a still smaller smattering of Kohwar, *i.e.* Chitrali, which I was able to employ in talking to the Prime Minister. Then I learnt a few, and only a few, words of Burushaski, which is very difficult and in which, apart

from the difficulties mentioned by Col. Lorimer, there is a Welsh "ll," which I personally had no difficulty in using. I think I was the second commandant of what was then the Hunza Rifles, and I found the Hunza people most charming and perfectly companionable. They are as active as any people could possibly be, and as I can see one or two members of the Alpine Club present, I may tell them that as slab climbers nobody in the world can beat the Hunza men. For very hard work in the mountains, if we had a trained body, they would not prove inferior to our best Sherpa porters. They were called out twice during the time I was in the Gilgit Agency. Once I was responsible for collecting them. Many of them came down from away up in the mountains from where their flocks were and were collected in Hunza by the evening, and from there they went to Gilgit in one march of 65 miles of very bad country indeed. In my time beyond Baltit, after you left the fort, there was no main road up; a great deal of rock climbing had to be done before you arrived at the Kilik pass. It was quite different from the main road, of which Capt. Morris showed you views. The Hunza man is very far removed from the savage. I will give you an instance of his sense of humour. In the old days he was attacked by the Nagyris. He was first threatened by the Kashmiri troops who were then in Gilgit, before we arrived in there. The Hunza men dashed down to have a slap at the Kashmiri troops as they came up the valley, beat them at Chalt, some 30 miles from Baltit, and drove them back to Gilgit. Then they heard that the Nagyris were attacking Baltit, so they went for the Nagyris, beat them, rounded them up, took every stitch of clothing off them and sent them back to Nagyr just as they were born. That had a first-class effect. The Hunza always prides himself on being more full of life and go than the Nagyr men, and the reason he gives is an excellent one because it confirms modern ideas as to the beneficial effects of sunlight. The Nagyris are cut off from sun for about four months in the year; Hunza gets the sun the whole winter. There is another fact which may bring comfort to the heart of many, and that is that quite half the Hunza people belong to the Malai sect, and in my days they grew grapes and made wine. They used it, too, and perhaps the cheerful little help they got from the wine, in spite of the fact that they live in that terrible country, has given them a better outlook on life. Who can tell? I cannot say more except this: that if there is trouble anywhere in that district it will be found that those splendid men who are absolutely devoted to our own particular rule will be of the very greatest help to us.

Dr. T. G. LONGSTAFF: I hardly dare speak, as I was also once a member of the Gilgit garrison! But there is one point I would like to make with regard to the lecture. You will remember that just as the party were about to go over the Shingshal pass with a view to begin the real work they had come for, hey were stopped by a telegram. I should not, however, dare to criticize anybody. I might want to go there myself. But I will say that it is not the military authorities that make trouble. There is always this danger of being suddenly stopped when you think everything is all clear. I will not criticize it; I won't attempt to explain it, and I would not dream of speaking the truth to you concerning it. But it is a thing which British officers even in the garrison around Gilgit are up against.

Though it is late I would beg to tell you one true story, and then I will stop. In 1907 Harold Whitaker, an officer in the Rifle Brigade, was at Ranikhet. We met over a man who had eighteen holes in him, made by a bear. We made friends while getting that man well. Whitaker wanted to go to Chinese Turkestan, to the Tien Shan, as he had a year's leave due to him. He applied

for twelve months' leave to go over the Karakoram, to Yarkand and Kashgar to shoot ibex in the Tien Shan, and spend a year up there learning something of the Turki language. He was told that he could do nothing of the sort, but that he was to go home and enjoy himself. He consulted me. He got a year's leave ex-India: eventually he went to St. Petersburg with the proper introductions. From there he was passed on to the anti-British Governor-General of Russian Turkestan, who passed him on to Kuldja, where he was passed through to the Tien Shan. There he spent a happy time, learning some Turki and other things useful to a soldier besides, and came back across the Karakoram pass three weeks before his leave was up. But the moment he reached Leh he was arrested by order of the Indian Government. That was not the work of the military department. He was held prisoner under the hospitable roof of my old friend the British Joint Commissioner in Leh, where he had a delightful time. But his regiment was very upset at having to hold a court of inquiry over the case of a Rifleman overstaying his leave. I could give you several other such cases from my own knowledge, but not another so positively comic.

I had told my friend Montagnier that as he was *not a British subject* he was pretty safe from interference (having already obtained official sanction for his route). I sympathize with his disappointment, and that of Capt. Morris, most sincerely.

The CHAIRMAN: The hour is too late to continue the discussion. I have asked Capt. Morris about the name "Dasto Ghil," and he says that is the name which was given to him. I am sure you will agree with me that the thanks of the Society are due to Mr. Montagnier for having rendered this expedition possible. We are grateful to him, and to the Mir of Hunza for the help that he gave Capt. Morris. As to Capt. Morris himself, we are delighted with the account he has given us and also with the really admirable slides which he has shown. In your name and in the name of the Society I beg to thank him.

A JOURNEY ACROSS THE SAHARA FROM KANO TO OUARGHLA: *A paper read at the Evening Meeting of the Society on* 5 *March* 1928 *by*

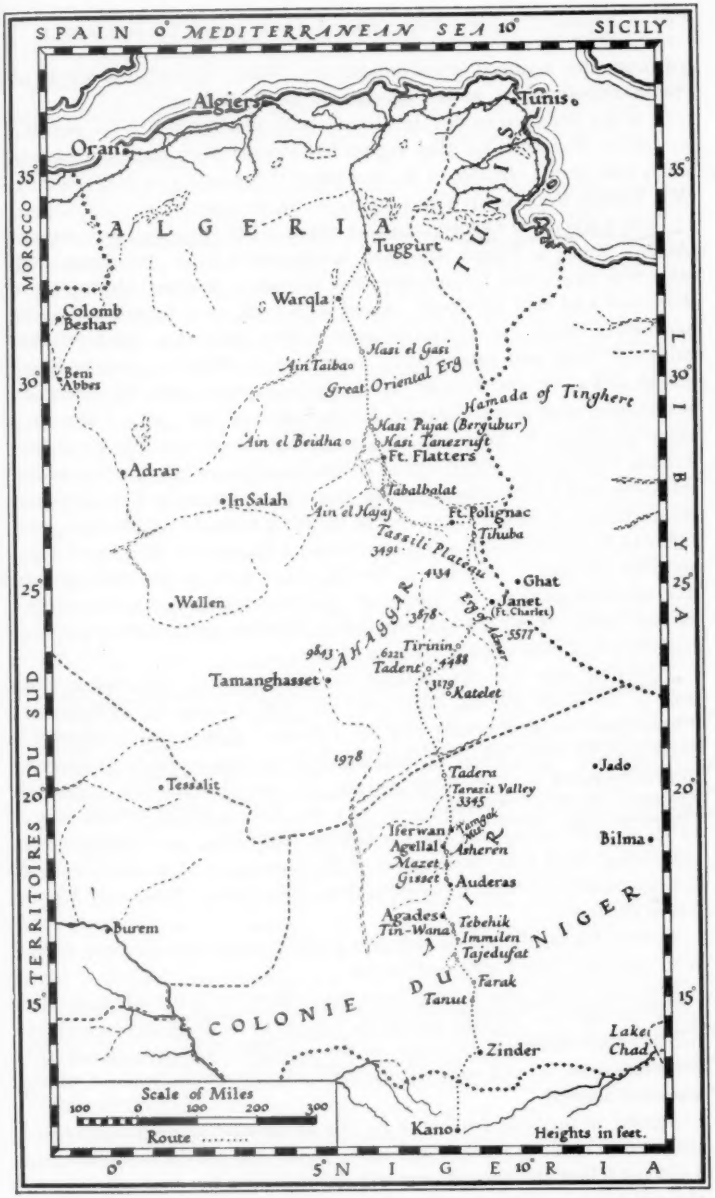
LIEUT. D. R. G. CAMERON, ROYAL SCOTS

IT is through the eyes of an ignorant though inquisitive traveller only, with a limited time at his disposal, that the portion of the Sahara which I traversed will be seen. I need hardly add, perhaps, that this ignorance of mine will be a lasting regret, more especially, I feel, with reference to geology, for which there seemed to be ample scope for study. All I could do in connection with this was to blindly take specimens of the various types of rock I saw and bring them home.

Serving as I was in Northern Nigeria on what may be called the threshold of the Sahara, I was already in an excellent position to attempt a south-to-north crossing, and there remained only to make the decision as to which route I would follow, always, of course, taking into consideration the question of time: a factor which influenced the conduct of the whole undertaking, for my leave was not unlimited. Kano, the railhead in Northern Nigeria, forms one of the southern termini of the former Tripoli–Western Fezzan–Aïr trade route, which was followed from the north by Barth and his two companions in 1850. A route which, starting from the south, coincides with this as far as Northern Aïr but then takes a more westerly direction by Tamanghasset in the Hoggar massif, and In Salah, to end at Ouarghla, had been followed by Capt. Angus Buchanan and Mr. Glover in 1922–23. The only route which apparently had not been followed by a Britisher was one between these two, lying to the east of the Hoggar and following the line Iferouan—Djanet—Fort Polignac—Fort Flatters and across the Great Oriental Erg—Ouarghla. This was the route that I decided to follow.

Of the French expeditions I will make mention of two: firstly, the Courtot Mission of, I think, 1920, which crossed from north to south by motor, following the route east of the Hoggar, Tunis—Fort Polignac—Djanet—Djado—Bilma—Lake Chad; and secondly, the Citroën expedition which on the first occasion followed the toute Algiers—In Salah—Tamanghasset (Hoggar)—Bourem, and later, Oran—Colomb Bechar—Beni Abbas—Adrar—Ouallen—Tessalit—Bourem and thence eastwards to Lake Chad *viâ* Zinder, where I crossed it at right angles. In the case of the Courtot Mission the route that I followed coincided with it between Djanet and Fort Polignac.

Djanet, although a comparatively extensive oasis, seems to have attracted little attention in former days, and this perhaps can easily be attributed to the fact that it was overshadowed by the larger oasis of Ghat, lying only 55 miles away to the north-east. Now however the Franco-Italian boundary separates them, and Djanet, which is the headquarters of this region of French territory and possesses a fort and



Sketch-map of the French Sahara: Names transliterated in R.G.S. II system

garrison, has assumed some importance. Ghat, as with the whole of South Tripolitania is, as yet, unoccupied by the Italians.

It is my intention to deal but briefly with that portion of the journey as far as Iferouane, for that region has already been more adequately dealt with than I am able to do, in a paper "A Journey in Aïr," read by Mr. Francis Rodd on 4 June 1923 (*G.J.* 62, 81–102).

I left Kano on 11 October 1926 accompanied by three natives: Sakari Adamu Kano, a Hausa who had accompanied Capt. Buchanan and who was not fated to complete the journey; Mallam Mustapha, a Beri-beri who had previously served as a cook to a French officer in portions of the desert, and as he spoke several languages, combined the duties of cook and interpreter; and Baragai Dabai, a Dakka-Kerri pagan and a very fine type of native, who was taken solely for his stout-heartedness and amply justified his inclusion in the party. The first stage was made by lorry and took us over the border to Zinder in the French Colonie du Niger, or, as it was formerly called, the Territoire du Niger, and it is from here that the journey may be said to have properly commenced. A sufficient number of camels was unobtainable here, and bullocks had to be taken as far as Tanout, a distance of 88 miles. This shortage of camels was due to the fact that most of the fully grown animals were away on the great salt caravan which concentrates on the eastern border of Aïr towards the end of October and travels across the bad stretch of desert to the salt-pits of Bilma.

Travelling now was not pleasant, for there is a very hot spell at this time of the year, and the discomfort was added to by the presence of "kerengia," or, as it is called by the French, "kram-kram," a form of grass bearing many small sharp-pointed burrs, which attach themselves to every part of one's clothing and are not only difficult but extremely painful to remove. Travelling on foot you have a choice of two evils: either to walk along the track which is loose sand and consequently very tiring, or to walk in the grass of the firmer ground at the sides and become smothered with these pernicious little burrs. Personally I preferred the former.

Tanout, the northernmost civil post in this region, possesses one white man only, and here I obtained camels.

The season of rains having been over some time, the effect on the water supply was already apparent, and at one village at least there had not been sufficient to water all the animals. The majority of the pools had dried up and most villages were reliant on wells, some of which were not overfull.

Agades, at the southern foot of the Aïr Mountains, was our next objective, and in order to reach it and at the same time get the best shooting, I did not follow the normal route *viâ* Aderbissimat, but took one more to the east by way of Farak, Taguedoufat, Ti-n-Nouana and Tebehig. In the belt of bush country which extends roughly 50 miles north of Tanout

considerable wild life in the form of white oryx, addax, ostrich, giraffe and three species of gazelle is found, and here I spent a week's hunting, and after some very exhausting work in a scorching sun managed to secure a few heads.

The well at Taguedoufat, where I left the bulk of my caravan whilst I went off shooting, I thought was interesting because of its width. It was not very deep—about 40 to 50 feet—but at the top was between 35 and 40 feet wide. For three-quarters of its depth the sides were of sand, but at the bottom it was bored into solid rock and narrowed to about 12 feet. Grooves, 3 inches deep, had been worn in the rock by the constant friction of ropes being pulled up and down. The natives say that it contains water throughout the year, but is liable to be filled in with sand when there is a high wind, and then has to be dug out.

By the time we had left Taguedoufat behind us—the early days of November—clouded skies had begun to appear, but unfortunately this was not an indication that rain would fall. A very strong north to north-east wind had also commenced to blow, and the loose sandy nature of the country in that part made conditions extremely unpleasant. The whole atmosphere is clouded with sand, which gets in everywhere—ears, eyes, nose, mouth and in all the food.

At Ti-n-Nouana, where during the early rains Mr. Rodd found the pool large and deep enough to dive into and swim in, I found just the smallest pool in a scooped-out hollow at the base of a large rock, and that had to be dug out a little in order to obtain sufficient water.

Agades was reached on November 15, and after a few days' wait in order to change camels, the journey resumed. A day's march from here found us entering the mountainous region of Aïr, and difficult travelling, mostly over broken and rocky country, was experienced as far as the little mountain-enclosed village of Aouderas. Ahadu, the chief of this village, was found to be extremely friendly, and was very helpful with his good advice. The normal route from here to Iferouane lies more or less due north, but again the prospects of getting better shooting—this time for mountain sheep—led me to take a more westerly route *viâ* Guissat, Mazet, Acherine and Aguellal. The type of travelling now varied from very good to very bad; at times over firm gravel flats and at others over broken boulder-strewn ground scarred with steep-sided and rocky gullies. The main mass of the mountains lying on our right hand protected us from the wind, which by now had become decidedly cold and necessitated lighting a fire after sunset. Two days were spent at Mazet in hunting sheep, but at the end of them I hadn't even seen one, and as our water was nearly finished and the well there dry, we had to move on to the next one at Acherine. We hadn't been on the move an hour the following morning when I ran right into a sheep and shot it. That and another I shot north of Taghazi were the only ones I managed to obtain.

The effect of a long rainless period was again seen on reaching Aguellal, the well of which had completely dried up and the inhabitants forced to evacuate the village. Aguellal, I thought, possessed the prettiest and most picturesque situation of any of the places I had passed through in this region. It lies in a shady thicket containing many large trees, some of them as much as 30 or 40 feet high, which after the harsh and barren nature of the country that had been passed through formed a restful and welcome relief. The towering pinnacle-like peaks of the mountain range behind formed a stately background, especially at sunset, when they showed up in glorious colours which changed rapidly as the sun got lower.

A day and a half's march round the northern side of the Aguellal Mountains brought us to Iferouane, lying on the Ighazar watercourse close under the western foothills of the Tamgak Range. During my enforced sojourn here I was able to make a journey up to the top of this latter mountain range, and there saw some of the wildest scenery of any I had yet seen. Just a succession of bare and gloomy ridges littered with enormous boulders, which in places were heaped up in natural cairns.

I was not prepared for the check which was to hold me in Iferouane for twenty-three days before being able to continue the journey. This was the inability to obtain a guide to take us over the rather formidable crossing of desert that lay between us and Djanet, the next oasis, a distance of about 380 miles, which includes a stretch of 150 miles of waterless and almost completely pastureless country. Communication from Iferouane, which is the northernmost military post in the Colonie du Niger, lies southwards and from Djanet northwards, and as a result the intervening stretch is a sort of No-Man's land, which few natives care to cross. The Kano-Tripoli caravan route lies across here, but the trans-Saharan slave traffic of former days being now dead, it is no longer in use. Contrary to the normal development of things, time, instead of decreasing the difficulties of travel, has considerably increased them, and but for the courtesy of the officer commanding a Camel Corps patrol that called at Iferouane on Christmas Eve, in lending me one of his guides, I might have been there yet. Guides to Tamanghasset in the Hoggar were not difficult to obtain, but it did not fit in with my original plan to travel by that route. The Tuareg guide I did eventually obtain had not been across to Djanet for some years, but he said that he was perfectly confident of the way.

We started on December 27, the party, besides my own three natives, consisting of two camel-men and the guide. Travelling north our first objective was the water-hole at Tararit, a distance of 80 miles. A noticeable feature now was the appearance of sand, which in the mountains south of Iferouane had been lacking except in the river-beds. Now however the surface was in many places loose sand, and drifts, several hundreds of feet high, reached almost to the summits of the hills. The country falls away gradually to the north and is everywhere dotted with

bleak hills and rocky formations. The sheltering heights of Tamgak now left behind, the full force of the wind was again felt, and all round there was a thick sand-haze. The well-vegetated "agoras," or valley of Taghazi, was entered on the 30th. To reach the water-hole the watercourse has to be followed up into the mountain group where it rises, and for the last three-quarters of an hour it is necessary to scramble over the rough surface of a narrow ravine. The water-hole is situated in a steep-sided bay where the watercourse commences an S bend. Two sides of the bay are overhanging cliffs, which have numerous Tifinagh writings and drawings on them, like those described by Mr. Rodd. The water-hole, dug in the river-bed, was partially filled in with sand and had to be dug out before sufficient depth of water could be obtained. A supply has to be taken from here for the next 192 miles, for although there is water at Tadjettaret, 42 miles distant, it is not good for drinking—at least not for a white man, although natives don't mind it. Two days were spent in order to allow the camels to have a good final feed, for this is also the last really good pasturage before entering the barren stretch of desert ahead. There were many signs of Tuaregs having been here just previously, but we did not see a soul during our stay.

The journey was resumed on New Year's Day, when we retraced our steps down the torrent bed and then struck off to the right and for five hours zig-zagged over and round stony-surfaced hills. The narrow track, which over the stony ground had been discernible, then opened out and disappeared on to a broad sandy-gravel plain, bordered by lines of low kopjes, partially covered with sand. The diminished size of the hills, the open nature of the landscape, and the increased velocity of the wind now indicated that the mountains were well behind us and that we were on the edge of the *tenere* (flat sand desert) and *tanezrouft* (flat gravel or pebble desert).

After three days' march mostly over fairly firm gravel and sand, but occasionally through groups of low rocky hills partially covered with sand, we reached Tadeghat. Through the hilly stretches a line of narrow parallel tracks had been visible, and the route was marked by heaps of stone thrown up by travellers in the past. It is a superstition that if you add another stone to the heap you will have good luck. It would seem that there is a more useful motive underlying this than the pure superstition itself, for it means that every stone thrown from the path is one less to try the feet of both camels and men. The country here is almost completely barren, and it was difficult to find good pasture for the camels.

The water-hole at Tadeghat lies on a slight rock-strewn rise in the ground, and the water-level is about 8 feet below the surface. The water contains "natron," and was quite green, and looked rather like pea-soup. One night was spent here only, enough to allow the camels to have a final drink, for the next water-hole, Katelet, was six days' long marches ahead, and as there was practically no pasture for them here I did not

want to stay longer than was necessary. A scattered group of dying thorn trees bearing a few dried leaves was all that could be found.

We left on January 4 and travelled all day till sunset. The first two hours were through sand hills and low rocky hillocks, and after that we emerged on to open desert. The rest of the day was spent travelling over a flat expanse of gravel and pebbles, with occasionally a patch of sand. To the west on our left hand a low irregular line of semi-sand-covered hills; to the east the ground rising slightly to form a low ridge and scattered in the distance a few small groups of hills. Not a blade of grass was seen all day, and a halt was made in the evening at the first vegetation we saw—one solitary shrub. This and some of the grass we were carrying was all that the camels could have. After five hours' marching the next day we came to a wide and low ridge which took us three hours to cross, and at the foot of which was a scattering of small trees, although there was practically nothing edible for camels on them. Over the rocky surface of the ridge we picked up the old caravan route, consisting of fifteen to twenty parallel tracks, and dotted at intervals with the sun-bleached skeletons of camels. It was only over rocky or stony ground that any traces of the tracks remained, for elsewhere they had been obliterated by the wind. Once over this ridge the ground resumed its flat nature.

The next day brought us suddenly to the top of a 30-feet cliff where the whole level of the country dropped. Three hours after passing this we reached a very welcome patch of grass, where a short halt was made and as many bundles of it taken as could be carried. It was fortunate that we found this, for no more was found for two days, and even then it was not sufficient for the already ravenous camels. Later on we were reduced to giving them the dry straw pads of the baggage saddles to eat, out of which they could have got but little nourishment. The only conspicuous object we saw during these two days was a cluster of black rocks sticking up like tombstones; otherwise there was nothing but flat gravel and pebbles with an occasional low ridge or hillock in the distance.

Since leaving the well we had seen mirage almost continuously, the effect of which, I thought then, was not unpleasing. All around us would be seen lakes of blue water, and in places where there were any hills the resulting effect would be that of a coast-line where the sea had broken in, forming numerous island-studded bays.

It had been intensely cold, and except for a few hours during the night a very strong east to north-east wind had been blowing continuously. Whilst lessening the need for drinking and so preserving the water supply, it was extremely unpleasant, for owing to the flatness of the surroundings there was no escaping it. It was necessary to wear a thick coat and walk all day, for after half an hour sitting on a camel travelling at a walk, one's limbs became numbed with cold. Walking in a high wind for a few

hours is at any time unpleasant, but when it lasts for roughly ten hours a day for days on end, and when you often have to walk over loose sand, it can only be described as vile.

The sixth day found us in country where hills were becoming bigger and more frequent, and ahead of us lay a group of conical-shaped hills ending in a steep-faced bluff. This the guide said was Katelet, where the water-hole was situated. The foot of the bluff was not reached until well after dark, and camp was pitched with the intention of locating the water-hole in the morning. A few small thorn trees were the only vegetation. Two of the camels had been left behind that day, utterly exhausted and unable to move, but it was hoped that, as we were supposed to be nearing the water-hole, water and perhaps forage could be sent back to them.

With the morning came the startling news from the guide—in whom I had had complete confidence and who had mentioned no word that he had any doubt as to not being on the right route—that this was not Katelet, that he could find no water-hole, and that he hadn't the slightest idea where he was. To add to the trouble, we could find no better pasture than that we had found in the dark the previous night. All our remaining water when collected together totalled between six and seven gallons. We were seven in party, and as I had no idea as to when and where we would get more water, I started straight away on a ration of a mugful each per day. All that day and the next were spent by the guide scouring the countryside for a familiar landmark, and by the remainder of the party in searching for water amongst the hills—all without avail; except that the guide said he thought we had come too far to the west. In this I felt certain, for since leaving Iferouane I had kept a record of our route by taking frequent compass bearings, and had commented to the guide on what I thought was a tendency to travel too far into the west. As, however, he said that it was all right and the accuracy of my map could not be relied on, I had said no more. On the third morning we set off in an easterly direction. What had become an almost equally important quest, as far as the camels were concerned, was that for pasture. All that day we travelled over and round hills of half rock and half sand, and except for a small patch of grass early on, we saw no vegetation, and halted at night with absolutely nothing for the camels to eat, and not a stick of wood with which to make a fire. My confidence in the guide was again shaken, for on arriving at the patch of grass in the morning I had stopped and given orders for as much to be cut and made into bundles as could be found, but he had interrupted and said that it was quite unnecessary as he now recognized the country and he knew that there was plenty farther ahead.

That day another camel came to the end of its tether, and I had to shoot it. What fluid could be found in its stomach was taken by the natives and used for cooking purposes, for the small ration of water allowed for no cooking, without which it is difficult for the native food to be eaten. They were now existing on my own stores.

Lying almost due east was a fairly prominent range of hills which we were now making for. A similar day's travelling to the previous one was again experienced, except that the country became more open, hills becoming more scattered and sandy and shingle plains more numerous. A few rocky stretches were crossed, and here the predominating rock, of which there were two types, was conspicuous by reason of its bright colours: one green, which lay about in large blocks and had the appearance of fossilized tree-trunks; and the other blue, which protruded from the ground in a diagonal slate formation. Not a blade of grass had been seen, and it looked as if we were to halt under the unpleasant circumstances of the night before. About 4 p.m., as we were nearing the range, however, the welcome sight of a camel's skeleton told us that we had struck a track. On reaching it we found that it led along a dried watercourse, where there were some small shrubs—sufficient for a good feed for the camels. The guide was now extremely optimistic, and said that we would reach water before noon the following day without fail. In fact, he said that I could kill him if we didn't. Although I had rather felt like doing so on occasions, it was not my intention to accept his offer, if for no other reason than that he was more use to me alive than dead. His hopeful forecast for the morrow had brought forth a request from the others for additional water. Not feeling so optimistic myself, I was compelled to refuse, although before starting the next morning I did give out just the smallest drop extra.

Following the track the next day we entered an abundantly vegetated valley running through a group of small mountains. There were many traces of Tuaregs who had been here with their animals previously, but there was not a sign of life or water now. We had crossed another track at right angles, which the guide said led to Ghat, many miles away. As I had feared, sunset found us with no better prospect of obtaining water. We had spent most of the day coming through the valley, but towards evening it narrowed, the vegetation dwindled to nothing, and we came out on to a small gravel plain. Here we found enough pasture, and halted. We were following some old camel tracks, and it was decided that the guide should push on ahead on his fast camel with the hope that he would either find a water-hole or a Tuareg who could direct him to one. The remainder were to follow as fast as the pace of a laden camel would allow. Sakari volunteered to accompany the guide on the back of his camel. Complete faith had been lost in the latter, and there was that fear that he might go off and not return, and as Sakari was so insistent I let him go. They started off by moonlight after a few hours' rest, taking with them a ration of water and some tinned food.

We started off on their tracks the following morning, and soon entered a range of mountains similar to those we had passed the previous day. The tracks of the guide's camel had joined on to those of four others that looked not more than three or four days old, and our hopes rose.

That afternoon we noticed that the earth in the bank of a watercourse we were following was damp, and we decided to halt and dig. This we did, but three hours' digging convinced us that if there was water there it was very deep, and that for men in a weakened condition it was an impossible task to reach it. The march was resumed the next day, and another well-vegetated valley entered. Tracks of animals everywhere covered the ground, and up in the rocks were places where pools had been but had completely dried up. The failure of the water supply had evidently driven every one away. After three hours we met the guide and Sakari returning with the bad news that they had found nothing. The latter was very exhausted after the long ride, but the guide, being a Tuareg and possessing wonderful powers of endurance, was not so affected. It was a bitter disappointment, for the comparatively fresh tracks that we had picked up had revived our hopes. It was impossible to carry on until Sakari had been well rested, so we retraced our steps to the place where we had dug unsuccessfully for water, and pitched camp. We made a further attempt at digging, but had to give it up as hopeless. Apart from the fact that the water, if any, was very deep, it was too exhausting and produced too great a thirst. That afternoon the guide went off in another direction accompanied by a camel-man on the strongest baggage camel. They were told to search the surrounding hills and to return not later than that night or the next morning. The following morning they had not returned, and all that day and the next there were no signs of them. It was an anxious time, for although I somehow felt that they were sure to return I couldn't altogether escape the feeling that perhaps they might not.

Dosed with a little extra water, some whisky, and a little of the very small supply of tinned milk which was being used to eke out the water, Sakari had become much better. It was with a shock and great surprise, then, that on trying to wake him on the afternoon of the 19th, and the tenth day since we realized that we were lost, we found he was dead. Although rather weak, he had shown no signs of being as bad as this, and must have passed away peacefully in his sleep. It was a sad loss to the party, for he was a very capable and intelligent type of native.

We had not finished burying him when a shout from Mallam of " Look ! there's some one coming ! " made me take up my binoculars. A few seconds' scrutiny was sufficient to tell me that it was the guide and camel-man, and by the presence of an extra man and camel and the bulges of water-skins on the sides of the animals, I knew that they had found water. So it proved, and in a few minutes we were having the first proper drink we had had for ten days. The guide had circled round to the west and gone back on our previous track to the cross tracks we had passed, and had there followed the easterly branch. He had picked up camel tracks, and following them had found one Asgur Tuareg looking after some

camels in the vicinity of a water-hole. It had been an unpleasantly close situation, for the water ration had been reduced to nearly half a mugful for the last few days and the party had become very weak. The camel-men had been drinking blood obtained by opening a vein in a camel's neck. This is apparently a common practice with Tuaregs when on long marches and short of water. After two days' rest to recuperate we started off for the water-hole—two days' march away. Returning almost as far as the cross track, we turned off to the left over a rocky path into a range of hills, where we entered a concealed well-vegetated valley. Following this up to the highest point of the range we came to a watershed from which, when it rains, torrents run in several directions. Tucked away amongst enormous boulders was a large and deep pool of good water lying in a cavity in solid rock. Here the camels had their first drink for nineteen days, and the amount of water they lapped up was astonishing. It seemed as if they would never stop.

Unpleasant though the cold easterly wind had been, it was the saving of the party, for neither men nor camels would have lasted much more than four or five days had the weather been really hot.

As far as I could make out from the Asgur, the name of the water-hole was Tarouadi. He knew little or nothing of the locality, and the only other name I could get from him was that of this region, which was Anahef. Katelet, he said, was south of us, but how far he didn't know, and Tighighi, the next well on our originally planned route, four days to the north. He said, "As he was only a boy, he couldn't be expected to know much about the country." He had been sent out from Djanet to look after his brother's camels. Our course from the Tadeghat water-hole had been much too much to the west and had led us well into the eastern foothills of the Hoggar massif.

We rested and reorganized for three days, and left for Tighighi on January 25, under the guidance of the Asgur, who was to come with us for the first day and put us on the right track, when it was hoped that our own guide would pick up his bearings. That day, much to my surprise, it rained—the only occasion on which rain fell during the journey. Although it was cloudy I was not expecting it, because for some weeks now we had experienced quite a lot of cloudy weather, but nothing had come of it. It had been spitting on and off throughout the day, and by the evening developed into a steady drizzle that lasted until 11 p.m. Had it come a week earlier nothing could have been more welcome, but coming now when we had water it merely caused great discomfort. The freshness of the first fall was very pleasant, but after an hour we had had enough of it, for we were not equipped to cope with rainy weather. We had spent most of the day wending our way along a narrow mountain track, but by the evening we descended to level ground, where we joined the Tighighi track. The following morning the Asgur, who was anxious to get back to his camels, left us. The route, he said,

In the Tamgak mountains, Aïr

In the Tamgak mountains

Djanet : village of Azelouaz

Summit of Tamgak mountains

Taghazi, Northern Aïr

Pool at Tarouadi

was well marked and we could not miss it, and the guide said that he was now sure of the way.

Travelling north-east parallel to a knife-edged ridge on our right, the path was clear until the ridge ended, and we entered a region of small sand hills. Here it was difficult to find the path, and we followed some camel tracks which led into a small valley. After some time I found that we were travelling due south. At first I thought it was because we were making a détour round a region of hills, but after a time realized that this couldn't be so. Not wishing to risk a repetition of our previous experience, I turned back to the point where we had commenced to swing round to the south, and not being able to find any definite signs of a path I sent the guide back to bring along the Asgur. The former seemed to have completely forgotten the route and hadn't taken much trouble to obtain information about it. They returned that afternoon, and we started off again the next day. The Asgur put us on the right route, and, after assuring us that we couldn't possibly go wrong now, again returned to his camels. Vegetation, which up to the present had been fairly plentiful, was now becoming less, and our way lay over alternate stretches of flat barren gravel and broken rock. To our left were two prominent parallel ridges running approximately east and west, and farther behind them a big rock mass, which had been in view for several days, and which as far as I could make out from my map, was called Tadent. We found no difficulty in following the track and arrived at Tighighi on the 30th. That morning we awoke to find that the baggage, which was still damp from the recent rain, was covered with heavy rime.

The country had developed into a series of gently curving low rocky rises, with an occasional gravel-bedded watercourse containing a little dried grass and scattered trees. Isolated bleak hills were dotted here and there. The water-hole at Tighighi is situated in a pebbly saucer-shaped depression, in a completely barren stretch of country. It was very shallow and the water contained " natron," but was quite drinkable. Pushing on from here we passed over a desolate stretch of gently undulating black shingle. The camels were on short rations again, for we could find very little for them to eat. As a result one more gave in and had to be killed. As much of the camel meat as could be carried was taken with us, for we were now running short of food.

On February 2 we sighted the Erg of Admer, a region of large sand-dunes which lay between us and Djanet. Considerable difficulty was now being experienced in picking up the track, for the ground surface had become sandy, and all trace of paths had been removed by the wind. After the days of having seen nothing but dingy and gloomy-looking shingle and rock, the glistening sand-dunes were quite a cheerful sight. After travelling more or less parallel to them for the best part of a day, the few indications which showed us our direction led straight into the

dunes at a point where they were a little lower than elsewhere. Even so they were about 50 feet high. Then ensued some extremely exhausting work, clambering up and down the loose sand, and with difficulty coaxing the camels over. With camels in such a weak state as ours were, it seemed to me that if this sort of travelling was to last much longer they would certainly never reach Djanet. However, much to our relief, after an hour's struggling we came to what proved to be the last dune, and at our feet stretched a long valley. Enclosed on either side by dunes, the height of which I judged to be over 100 feet, the lower stretch of dunes over which we had come, formed a barrier blocking its entrance. The valley bed was flat and of sunbaked mud, and, by the innumerable deeply imprinted camel tracks, had evidently been a marsh after the last fall of rain. There was a white crust on the surface, which made it look as if there had been a light fall of snow. That evening my attention was attracted by a solitary dragon-fly flitting round the lamp. There was no vegetation in the valley, and we had to rely on what little fuel and fodder we were carrying.

After travelling along this valley for some distance we branched off to the east into a similar, though larger, one, which sloped down gently to the north-east to end in an extensive group of rocky crags. We were nearly at the end of the dunes and were again finding it difficult to pick out our way, but eventually after toiling up a sandy slope we came to a clearly defined track marked at intervals with pairs of stones and along which were the tracks of a motor. This was the Djanet–Tamanghasset track, which had been marked out for the visit of the Commandant from Ouarghla some time previously. Once out of the dunes the country fell away in a broken mass of rugged crags to a large valley in the east. We were now in the mountainous region of the Tassili-n-Ajjer. Tassili is the name applied to the rock formation here, which has a very prominent horizontal stratum. The ground surface and bases of these outcrops of rock were loose sand. In the distance the lofty cliff face which lies between Ghat and Djanet was plainly visible, stretching away to the north-west and south-east. We descended into the valley, wending our way round the numerous outcrops, and entered the oasis of Djanet on February 5.

The bright green of the date palms was the most pleasant sight we had seen for a long time. The six camels out of the eleven we had started with were at their last gasp, and had only just staggered in. We had seen one human being only during the forty-one days that it had taken us to come from Iferouane. Nothing can be seen of Djanet from the distance, for it lies tucked away in a narrow rocky-sided valley about three-quarters of a mile long and of an average width of 500 yards. To the west the country rises in a confused mass of rocky hills and ridges to end in the dunes of the Erg of Admer, which enclose it on the west and south-west. Stretching to the east for just over 8 miles is a region of

hills of heaped-up piles of rock, the ground surface in between being sandy and level. This ends abruptly in towering cliffs through a gap in which the Ghat road runs. The formation of these cliffs is that of a series of semicircular breastworks jutting up perpendicularly out of the piles of broken rock which are formed at the base. I was told by one of the two French officers in the garrison that they are well over 2000 metres above sea-level. Looking at them from Djanet—8 miles distance—I doubted this, but on going up to them I could well believe it, for they seemed to be well over 1000 feet above ground-level. The valley in which the oasis lies runs roughly north and south, and the western side forms an almost continuous cliff, in places perpendicular. The eastern side is more broken, and is more in the nature of a chain of steep hills. The valley bed, along the centre of which is a dried watercourse, is of loose sand. Thickly clustered along its sides, and to a lesser extent in the middle, grow date palms, under which are many cultivated plots, divided for irrigation purposes into squares by small channels. Each plot has its own well or water-pit, and there are as many as 140 in Djanet. In several of these pits stagnant water has lain for some time, and as a result they were overgrown with weeds. In these the germs of "bilharzia" breed freely, and I believe that most of the natives there suffer from the disease. The valley shows up in sharp contrast to the dingy-coloured rock which surrounds it, by reason of the vivid green of the palms and the crops. The recent fall of rain had caused the latter to spring up about 6 inches above the ground.

There are three villages in Djanet, all lying close under the sides of the valley. To the south and on the western side, Adjahil; to the north, on the eastern side, Azelouaz; and lying between them on the east, El Myan. There is also a very small cluster of hovels named Ramat, lying in the northern entrance to the valley. They are built on small rocky rises and the huts are jumbled up amongst clusters of large boulders. The houses are built of stone and are flat-roofed, each possessing a small yard surrounded by a high wall, the entrance to which is through a palmwood door. These doors are all kept locked. Narrow alley-ways lead through the villages. Most of the houses were in a very dilapidated condition, and where they were falling to pieces no attempt had been made to repair them. These villages are mean and dirty in the extreme, and the strong odour rising from them does not encourage you to stay longer than you can help. The only buildings which were in a well-preserved condition were the mosques in Adajhil and Azelouaz. The chief's house stood apart from the villages at the foot of the fort, and was larger and a little more imposing. The one prominent building is Fort Charlet, which lies up on a rocky spur at a point where a smaller branch valley runs off to the east. It is stone built and whitewashed, and a portion is the old original fort built by the Turks during their occupation. During the Mohammedan revolt of 1916–17 it was besieged for eighteen

days, and the garrison forced to evacuate it owing to water and supplies running out. It still bears the bullet-marks of the siege.

The inhabitants number about 800 in all, and are a mixture of Asgur Tuareg and negroid slaves from the Sudan. They spend their time cultivating their plots and gathering the dates during the season. The Asgurs proper lead a nomadic life out in the Tassili, their moves governed by the location of water and pasture for their animals. There was a strange furtiveness about the natives of Djanet as if always in fear of something; a natural outcome, I suppose, of years of living in continual fear of raiding parties. This is more noticeable amongst the women and children, who scuttle into their houses at the sight of a white man, the children often bursting into tears. Most of them were filthy dirty and on the verge of starvation. The date season and harvest had been over for some months, and those who had had sufficient foresight to lay aside a store had practically exhausted it. Their chief diet consisted of some form of grass, palm-tree bark, and old dried date stones ground up into a kind of flour, and to which those who were lucky enough to have it added a little corn. Apart from this they had a very limited supply of goats' milk, and, on very rare occasions, the flesh of a sheep or goat. It was not an uncommon sight to see a starving wretch, clad in rags and covered with flies which he made no attempt to brush off, drag himself up to the terrace outside the fort, and there lie until given a handful of dates, which was all that could be spared from the store. The garrison is entirely reliant for its food supplies on convoys from Ouarghla, a distance of nearly 800 miles, and one being long overdue, it was on bare rations. This period of famine occurs annually, but the natives seem to take no steps to guard against it. When food is plentiful they eat as much as they can and sell most of the remainder. Occasionally caravans go down to the Sudan for corn, but only rarely, for few care to undertake the journey.

The rain which had fallen on January 25 was the first heavy rainfall that had occurred here for three years. It had evidently been heavier here than at the place at which I experienced it, for I was told that in one small watercourse water had actually flowed for the first time in twenty years. If the fall is very heavy the resultant torrent which comes rushing down the valley uproots many of the palm trees, thereby undoing much of the good it has done in watering the oasis. This had once occurred, causing serious damage, and but for this there would be many more date palms in Djanet to-day. Even the last fall had loosened some of the smaller trees in their roots.

During our stay the wind was very strong, and the cold weather continued. On many days the atmosphere was so thick with sand that it was impossible to see more than half a mile, and all would be dark and overcast.

We were forced to stay here until March 2, for it was not until then that

we could obtain fresh camels. There is no good pasture in the immediate vicinity of Djanet, and it consequently takes a long time to search out the camels and their owners, who are usually hidden away in the mountain valleys of the Tassili. The next stage of our journey was to Fort Polignac, and lay through the mountainous region of the Tassili-n-Ajjer. Travelling almost due west, the first day was spent zig-zagging through the almost sheer-sided Tassili until coming out on to the northern edge of the Erg of Admer. For three more days we continued in a westerly direction, the sea of dunes to our left, and forming an impassable barrier on our right, the weird-shaped peaks of the mountains, which in places appeared to rise well over 1000 feet from the ground-level. The shapes of many of these mountains I could only compare with that of an oval-shaped blancmange, turned out of a mould and the base, being somewhat "squashy," having subsided and spread out. Almost everywhere, where there was a patch of vegetation, could be seen the beneficial results of the recent rains: parched and dried-up tufts of grass were now half green with fresh blades; trees, apparently dead, were sprouting fresh foliage; and springing up out of bare sand were tiny shoots from wind-scattered seedlings.

By March 6 we had passed the main mass of the Tassili, and had turned north along a wide valley with the mountains now on our right hand. Others could be seen to the west and south-west. On coming to the head of the valley we entered lower mountains of the Tassili by a narrow and tortuous path cut in steep rock. Reaching the top we continued over fairly level ground until reaching a plain of black shingle. This plain forms a small plateau, and on reaching the other end we commenced to descend by a long winding ravine named Haghir. The path is clearly marked by stones placed in pairs at intervals. Nearly a whole day was spent in travelling down the ravine, the path sometimes halfway up one side, sometimes halfway up the other, and at others along the bottom. Bare gloomy-looking Tassili and slag-heap hills formed the sides, and many branch gullies led into it. One of these dropped down in steps of flat slabs of rock, and in the steps large pools of water had collected. Here we met a complete family of Asgurs on the move to a new place of abode. They were moving everything, lock, stock and barrel, with their camels and donkeys, and were accompanied by old women and young children. There was a certain aloofness about them, and beyond stopping for a few words with my camel-men did not show any desire to fraternize with the party. As with nearly all the men in this region, those of this party openly carried rifles.

We had met a courier from Fort Polignac a few days previously, and he had given us the information that just before he left there had been an alarm there, as a raiding party from over the Tripolitanian border had been reported in the vicinity. Scouts had been sent out but had seen nothing, and it was presumed that it was either a false alarm or they

had dispersed. I heard later on when I reached Fort Flatters that a party had left Ghat and was somewhere in the neighbourhood, and that the mobile section was moving down from near Fort Flatters to that area. This was the only time during the whole journey—at least, to my knowledge—that it was even suggested that we were in the vicinity of raiders. I had heard of raids, but these had taken place many hundreds of miles away.

Having reached the end of the ravine, we spent a day's march of nine hours crossing a very broken area of black rock ; here in large sharp-edged boulders, there in pebbles, and in many places in thin flat slabs. This latter formation gave the impression that the ground had once been covered with flagstones, but that they had been broken and torn up. A gloomy desolate place, for even though the sky was cloudless and the sun shining, the black colour of the rock made it appear dark and overcast. Everywhere was there mirage dancing off the rocks, and when the wind fell the heat seemed to rebound from the rock with a scorching fierceness. On reaching the end of this rocky stretch the cliff face of the mountainous formation of Fadnoun can be seen to the north. This formation continues for about 50 miles in a northerly direction as far as Fort Polignac. To reach the latter place two sides of a right-angled triangle have to be travelled over : at first to the north along the eastern side of Fadnoun, and then about 20 miles to the west along its northern end. There are more mountains to the east of Fadnoun, and dividing them a narrow valley or " Oued " known as the Oued Imihrou. It was through this that we had to travel. It varies from 50 to 150 yards wide, and for a large portion of the way the sides are walls of bare rock. There are many large bushes and a few palms growing in it. The recent rain had converted it into a torrent, and it had been impassable for twelve days afterwards. When I went through, any obstruction in the shape of a tree or bush was choked at the base with wrack and brushwood torn up and washed down by the flood. Water-holes were fairly frequent. About 20 miles up the valley is a place called Tihoubar, where two natives were found cultivating a small fenced-in piece of ground. Amongst the undergrowth at the foot of a palm tree here is a spring of hot water bubbling up from underground. It is reputed by the natives to possess healing effects.

We were glad to reach the end of the Oued Imihrou and get into open country again, for enclosed by walls on either side, as we had been, it had been unpleasantly hot and stuffy. We could hear the wind whining overhead, but there was not a breath of air down below. Another form of unpleasantness was the flies, with which the place literally swarmed. There was no peace from them during the day, but at nightfall they would cease their activities and retire to the foliage of bushes. If you looked closely at a bush after dark you would see that it was absolutely black with them. In the day-time food had to be taken with a fork in

one hand and a fly-switch in the other. I would sometimes light a fire of green branches, and here I would sit in the smoke as long as it was bearable, if only to get a change of torment!

Fort Polignac, or Mileji as it is known to the natives, was reached on the 13th. It stands on a wide open "Oued" running east and west consisting of small mounds of sand well sprinkled with shrubs and trees. To the south the line of the mountains we had passed and to the north a region of low sand-dunes. The fort is situated on a slight rocky prominence where the surrounding ground is covered with pebbles. On the north side is a small cluster of huts containing not more than fifty inhabitants and a small area of cultivation. As in Djanet, I found a few of the natives spoke Hausa. The rain which had fallen to the south had not reached as far as this, and none had fallen for four years.

We stayed here until the 16th, and continued with different camels. I was accompanied from here onwards by a French sergeant and an Arab soldier, who were going on leave, and as the camel-men were Arabs returning to Ouarghla after having been down on convoy work, every one was anxious to push on as quickly as possible. As a result we covered the 580 miles to Ouarghla in twenty days, which included one day's halt at Fort Flatters.

Fort Flatters is about 230 miles north-west of Fort Polignac, and the intervening country consists of a region of large dunes. Projecting from the south into that region is a tongue of mountains which narrows to a point and ends about 45 miles south of the former place. The route lies along the eastern side of this tongue. The first day's travelling is along an open Oued possessing good pasture all the way. For a short distance a small formation of hills is on the right and a strip of dunes on the left, but after that a cut is made through this strip, and from then onwards there are the dunes on the right and away in the distance to the left the mountains. The next day we crossed a tract of smooth sun-baked mud, and except for two short rocky stretches, it was good going. I noticed here that the dunes possessed three distinct colours—pale yellow, orange, and a deeper orange. The route is well marked by large mounds of rock erected at conspicuous points. On the third day the path converged on to a mountain range which ran diagonally across our left front, and we ended up by travelling parallel to it. At the northern end of this range is the water-hole of Ain el Hadjadj. The old fortifications used by the French to guard the well during the revolt are still standing, and there are graves of soldiers who were killed in a fight with the Tuaregs, which took place in 1917. It is 43 miles from here to Tabelbalet, and practically the whole of this stage is black-pebble desert. The tiny oasis of Tabelbalet lies at the foot of a stony ridge which rises up in prominent twin peaks. It is uninhabited and consists of a small cluster of trees, half a dozen date palms, a ruined hut, and some old French fortifications, all clustered round the water-hole, in which the water is about 4 feet below

the surface and is good. Near by is the grave of a member of the Fourreau Lamy military mission, who died here in 1898.

Ten miles from here the mountains end and the dunes have to be entered, and a feature standing out prominently in the surrounding sand is the solitary rocky peak of Kranfoussa. The dunes continue to within 500 or 600 yards of Fort Flatters, but most of the way can be picked out along the firm sand of the hollows, and it is not often necessary to have to actually cross the dunes themselves, although when it is it is very tiring and heart-breaking work.

Fort Flatters, or Temassinine, is situated on a low knoll in a barren "oued" running east and west, the northern bank of which is a low white cliff. It was certainly the most desolate and lonely post we saw, for except for a very small cluster of date palms, a water-hole, and a few huts sheltering not more than a dozen natives, there was nothing else here but the fort. There is no pasture in the close vicinity, and fuel consisting of old boxes and what wood can be brought from a distance is carefully husbanded inside the fort. The landscape is particularly dazzling here, as the sand is scattered with pieces of white, almost transparent rock, which looks like washing soda, and in fact is said to be good for washing clothes. Whilst here I obtained some specimens of flint arrow-heads, which subsequently the British Museum kindly classified for me as being of the Neolithic type, although, I was told, they could not be placed in any definite period as they were not found in connection with a datable geological horizon, and apparently the period of the Neolithic Age in this part of North Africa is still unknown.

To all intents and purposes from here to Ouarghla was the last stage of the journey, for there civilization commences and modern means of transport are available. Of the 350 miles which comprise it, roughly 200 miles are through the Great Oriental Erg, a vast expanse of dunes, and but for the fact that we were accompanied by at least two Arabs who knew the route well it would have been a far tougher proposition than the journey from Aïr to Djanet, as here a 250-miles stretch of waterless country has to be negotiated. Fortunately for travellers, a series of valleys or corridors run from north to south through the dunes, and only for short periods is it necessary to clamber laboriously up and down over the dunes themselves. There are two routes: the western, by El Biodh and Ain Taiba; and the eastern, by Hassi Tanezrouft and Hassi el Gassi. The former, whilst not involving so long a waterless stage, is more difficult travelling, as more dunes have to be crossed and is several days longer, so it was decided to take the eastern route.

The start on the final stage was made on March 25. We were carrying our full capacity of water, for no more is obtainable until El Gassi—250 miles distant—is reached. At Hassi Tanezrouft, 38 miles from Fort Flatters, there is a well, but the water it contains is only fit for cooking purposes. The first 50 miles travelling entails the crossing of the Hamada

The old Air-Ghat caravan route, two days out from Tadeghat

Tighighi water-hole

Djanet from the west: Fort Charlet and the cliffs of Ghat beyond

Sand-dunes in the Great Oriental Erg

The Tassili-n-Ajjer, between Djanet and Fort Polignac

Djanet from the east: village of El Myan in the foreground

of Tinguert, a desolate region of rocks and pebbles, which is entered by one of the gaps in the low cliff north of the fort and rises in a series of steps or small plateaux. These steps are defined by low flat-topped cliffs similar in formation to that at Djanet, viz. an extended line of semicircular projections having the appearance of breastworks. Standing isolated from the cliffs are numbers of cone-shaped kopjes which look as if the tops had been cleanly sliced off with a knife. Having passed through the last cliff, a flat region of boulders and pebbles is entered, and travelling is along one of the numerous gullies that intersect it, until coming to the dunes of the Erg, where the last patch of good pasture for some days is found at Bel Guebbour. This place is marked on the map as Hassi Puja and as possessing permanent water, but the well was quite dry. From here we commenced travelling along the corridors through the dunes, the surfaces of which are chiefly firm gravel and shingle, and consequently it is possible to move at a good pace. We did the fastest travelling of the whole journey here, and for five days averaged 38 miles a day, which meant doing daily marches of anything up to fourteen hours. The corridors varied in width up to 2 miles, and along the edge of the dunes which enclose them on either side grow scattered patches of "had," a small prickly shrub.

Between 2 a.m. and 3 a.m. on the 28th we were struck by a violent sand-storm. We were on the move at the time, and were forced to halt and lie down, covered with blankets, behind the kneeling camels. A hot westerly wind had been blowing previously, but it suddenly changed round to the north and became icy cold, and the storm was on us before we knew where we were. It was quite impossible to face, and we were unable to continue for an hour, when it abated somewhat, although it still blew hard and the atmosphere was clouded with sand.

On April 1 we reached the well at El Gassi and had cleared the main part of the huge dunes of the Erg, which, except for those places where it had been necessary to cross from one corridor to the other, had not troubled us very much. Even in this parched and waterless stretch, as almost all the way through, we saw a few tracks of gazelles, although it is difficult to understand how they live; they must go without water for periods of years.

Five more days over sandy undulating country on which small shrubs grew in increasing abundance, and in which an occasional broken hilly region occurred, brought us to the edge of a cliff, and stretching away at our feet as far as the eye could see were the palms and lakes of Ouarghla, which we entered on April 5. Motor was taken from here to Touggourt, and the remainder of the journey by rail to Algiers, which was reached on April 12, just six months after the start from Kano.

As to final impressions, I think that the first which comes to one's mind is that of the terrible poverty of this vast area, and there will always remain a picture of a handful of beings barely squeezing an existence out of a parched wilderness where water is infinitely more precious than gold; for

it is water that rules everything. It seems a pity that nature cannot be more generous with its supply, for on those occasions when rain does deign to fall it is astonishing to see the speed with which vegetation springs to life, and much that is now a barren waste might be converted into comparatively fertile land.

From what little I saw of the pure-blooded Tuareg—for it *was* little, because living as he does hidden away in the mountain valleys much is not seen of him unless you purposely go and search him out, and that I hadn't time to do—it seems inevitable that as a race he will eventually cease to exist. Born and bred a marauder, but now more or less deprived by the advent of a European administration of the one mode of living that was congenial to him, his distinctive characteristics will disappear. The peaceful, though unremunerative, nomadic existence does not appeal to him, and a sedentary life of tilling the soil is beneath his dignity. By increasing intermarriage he is fast becoming absorbed into the semi-negroid population of the oases, and that, it seems, will be the ultimate fate of the whole race.

An impression that cannot fail to remain with any one travelling through the desert during these months is that of wind—a piercingly cold and, more often than not, sand-laden wind which seems to blow with a vicious spitefulness. From November until almost the end of the journey it was with us more or less all the time, and on those few occasions when it fell the intense heat that replaced it was almost a welcome relief. If you sat on the windward side of a rock or shrub you quickly became cold and smothered in sand; if you sat on the opposite side for long you became scorched with the sun. You could either ride a camel and shiver or plod along all day on foot and be warm but become very exhausted. So in most things here you have a choice of two evils, which perhaps is better than having only one, for you can at least switch from one to the other and so obtain a little variety. However, despite its discomforts, the desert possesses a peculiar attractiveness, and having just skimmed rapidly through its vastness, a desire remains to learn more.

I cannot conclude without mention of two things. In the first place, I would take this opportunity of expressing my thanks for the great assistance given to me by the French authorities, both in the Colonie du Niger and the Territoires du Sud. At every post at which I called I was shown the greatest hospitality and given every assistance; in fact, treated as a brother officer.

In the second place I must acknowledge the loyalty, under at times very trying conditions, of my three permanent native followers, two of whom completed the journey with me and one whom we left buried to the east of the Hoggar; in particular Baragai Dabai, who during the period when we were lost, although suffering badly from thirst himself, did his utmost to encourage the remainder when they became despondent.

Note: The names in the paper are spelled in the French system of transliteration. On the map, for comparison, they are spelled in the R.G.S. II system.

DISCUSSION

Before the paper the PRESIDENT (Col. Sir CHARLES CLOSE) said: It will be remembered that some little time ago Mr. Francis Rodd gave us a paper on the Southern Sahara, and we are later to have another paper from him on some further explorations in that region. To-night we are not dealing with Mr. Rodd's explorations, but with a great journey undertaken by Mr. Cameron across the Sahara from Kano to Ouarghla. Let me remind geographers, who are interested in the history of geography, of the first journey that was ever undertaken across the Sahara from the Mediterranean countries to Nigeria by white people. That was the journey made by Oudeney, Clapperton, and Denham, who started from Tripoli in the early part of 1822, one hundred and six years ago. In the course of that journey, which also included the journey back, Clapperton's two companions died, so that Clapperton alone finished. From Tripoli he went to Murzuk and on to Bilma, thence to Lake Chad and Kuka, as he called it then; we call it Kukawa. Then he went on to Kano and Sokoto, and back by approximately the same route, so that he covered the journey from Kano to the Mediterranean, more than one hundred years ago. Whilst we give every credit to the fine series of explorations that have been carried out by the French in their great territory which stretches from the north of Nigeria to the Mediterranean, and whilst we also feel deeply the losses which they have incurred in carrying out those journeys in many cases, still we cannot help feeling a certain sense of pride that it was due to the inhabitants of these islands that the first connection was made by white people by journey from the Mediterranean to Nigeria. I have mentioned the journeys of Mr. Francis Rodd, and we are to listen to the account of a great journey by Mr. Cameron. You will wish me to say, what is undoubtedly the fact, that those journeys could not have been undertaken but for the goodwill of the authorities of France. It is very largely due to the kindness of General Despres, who is with us now, and of the French authorities in Africa, that Mr. Cameron was able to undertake his journey. Such a journey is not a pleasure trip, as you will shortly hear. I will not anticipate the lecture, but ask Mr. Cameron to begin now.

Mr. Cameron then read the paper printed above, and a discussion followed.

The PRESIDENT: We are honoured by the presence of General Despres, the French Military Attaché. I will ask him to say a few words.

General DESPRES: Je vous demande la permission de dire au Lieutenant Cameron combien je suis heureux de la connaître et tout le plaisir que j'ai éprouvé en l'entendant raconter son interéssant et dangereux voyage. Je ne connaissais en effet jusqu'ici le Lieut. Cameron que de nom, par suite de la correspondance que j'avais échangée à son sujet avec le Gouverneur de l'Afrique occidentale et de l'Algérie.

Je suis d'autant plus heureux de faire sa connaissance aujourd'hui que je constate, d'après le récit de son voyage, que j'ai bien failli ne pas pouvoir le connaître du tout. Ce qui m'aurait fait du très grand plaisir de lui exprimer toute mon admiration pour le calme courage, le sang-froid, et l'endurance dont il a fait preuve. Une autre chose m'a fait le plus grand plaisir, c'est d'apprendre l'accueil qu'il a reçu des autorités françaises sur le territoire

français qu'il a traversé. J'y vois en effet une nouvelle preuve de cette cordialité de relation et de cette bonne camaraderie qui s'est si heureusement etabli entre nos deux armées pendant la grande guerre et dont je suis un partisan convaincu. Ce qui s'est passé pendant le voyage de Lieut. Cameron a eu déjà un heureux résultat. Mais en nous placant à un point de vue plus élevé et plus général, je crois que les resultats peuvent en être encore plus considerables. Je crois en effet fermement que tant que ces sentiments existeront la paix sera assurée, et en bon militaire qui est le premier à se rendre compte combien la guerre est une chose à éviter, je tiens à voir se maintenir cette paix peut-être encore mal assise mais que l'entente entre nos deux pays ne peut que continuer à affermir tous les jours.

Mr. FRANCIS RODD: Having returned only a few weeks ago from one of the areas through which Mr. Cameron passed, I can perhaps speak about a certain part of his journey in a way in which he would not like to speak about it himself. Anybody who has travelled in those parts will know what it means, not only to run short of water but even to be in danger of running short. When that has not only happened, but the travellers have survived ten days during which they have been reduced to a ration of one cup a day, no words I use here to-night can express my admiration for Mr. Cameron and for his party. It must be given to very few to survive an ordeal of that sort; to none, I am sure, without the pluck and the courage which he showed in bringing his party through. Apart from this, it would ill befit me to say more about his journey, because I only know the southern portion of the country through which he passed. Moreover, you have already heard something from me, and may, I am afraid, have to hear a bit more one day, so I will say nothing now.

Lieut. Cameron has touched on one subject which is particularly dear to some who have travelled in French colonies. I have been on my second trip exclusively in French territory, and if the French Military Attaché will permit me I would like to associate myself with Lieut. Cameron in thanking him and asking him to thank the authorities, who gave us both permission to travel at different times, for the reception which they accorded us. I think without trespassing on delicate ground I can repeat what I wrote when I came back in 1923: that if relations between our two countries were even remotely similar to those which existed between Lieut. Cameron, myself and the French authorities in French Africa, I suspect that the diplomats of our two countries would shortly be joining the ranks of the unemployed. I would like to take this opportunity of asking you to realize how grateful we are for all we have received at French hands, and how much we admire the French officers who are administering and keeping order in those particularly desolate but very interesting countries.

The PRESIDENT: There are not many present who have travelled in the Central Sahara, but you will agree with me that we have listened to a lecture which is of very great interest and shows what may be done by courage and endurance. I think we shall also all agree with what Mr. Cameron and Mr. Francis Rodd have said about the admirable relations between the French and the English in that part of the world, and how much the English travellers owe to the French authorities and, indeed, the admiration we all feel for the work that the French are doing in that immense stretch of territory.

We shall carry away with us one other idea, and that is that the huge area which he has described is one of the last on the surface of this world which will be vulgarized, and we may hope it will remain in its primitive state for a very long time.

THE ISLAND OF TAHITI: *A paper read at the Afternoon Meeting of the Society on 13 February 1928 by*

CYRIL CROSSLAND, M.A., D.SC., F.Z.S.

THE three easternmost groups of Polynesia differ one from another in a remarkable way: the Society Islands and the Marquesas are high mountains of volcanic origin, while the archipelago between them is the other extreme, being, with two exceptions, Low Islands, or Atolls. The Societies and Marquesas also differ: in the former the original volcanic cone is still easily traceable, the mountainous interior is surrounded by a fruitful flat upon which the inhabitants live, and the whole is enclosed in a great coral reef, while the latter islands are so much older that their original structure is quite disguised by denudation and faulting,* and there is not, and apparently never was, either maritime flat or coral reef—a fact which has had great social and economic consequences.

The Society group occupies an area elongated from south-east to north-west, roughly parallel to the similarly elongated areas of the Tuamotu archipelago of atolls, and other groups between them and Australia. These are parts of arcs, others being indicated by the emergence of the Solomons and New Hebrides, Tonga, Samoa, etc. The Fijis represent the last outposts of continental rocks, east of which all islands are purely oceanic, founded upon the summits of wave-like folds of the floor of the Pacific. The juxtapositions of volcanic and coral islands with great deeps, most clearly seen perhaps in the Tonga group, is significant. This system ends with the Marquesas, which are grouped, not festooned, islands, and which, in consequence of being on the edge of the solid unfolded block of the Pacific, 3000 miles wide, between them and the coast of America, show faulting on the great scale. The theory of the wave-like folding of the floor of the Pacific, giving this striking parallelism to many of its archipelagos, is well founded,† but it requires to be tested by more soundings.

All the Society Islands are volcanic, and all recent. The similarity and simplicity of their plan, a central volcanic cone surrounded by a maritime flat, which is the shore of a lagoon enclosed by a barrier reef, and the regularity of the reefs, are the most striking features of the whole group. The islands differ in age among themselves, and appear to form a series from the practically unaltered cone of the little island of Meetia, which is stated to be without reefs, and to be cliffed to only a trivial extent, through the twin cones of Tahiti and Taiarapu to the more mature erosion forms of Moorea and the leeward islands, to the half-atolls and atolls of the north-west and the atoll of Tetiaroa on the east.

* L. J. Chubb, M.Sc, *Geological Magazine*, 72, 369–373, August 1925. Quoted by present writer in *Trans. Roy. Soc. Edin.*, 55, Part II, 1927. Mr. Chubb's full account is still in MS.

† Molengraaf in this *Journal*, February 1921; Sir G. Lenox-Conyngham in this *Journal*, April 1925; Suess, *Antlitz der Erde*, vol 4, 301–323.

Porapora,* on the north-west of the group, is an oft-described example of an atoll in process of submergence. Whether this is so, or whether, for instance, the central lagoon is a crater basin formed nearly at its present level, might be best decided by examining every island in the group with reference to its age, state of erosion, the size and composition of the original volcano, as well as the history of its coral reefs. It seems likely that the Society group provides an evolutionary series, the comparison of which will not only give the history of the islands more certain than that based upon the examination of one at a time, but may lead to conclusions applicable to other groups, or even to the reefs of the world. In comparison with the Society Islands, others of the Pacific, such as Samoa and the Fijis, are complicated both in their origins and histories, and the relationships of their reefs correspondingly difficult to unravel. A logical attack on the coral-reef problem would begin with a full examination of the Society Islands, proceeding to more complex cases when these simpler are fully understood. The description of the islands, shores and reefs of Tahiti, Taiarapu, and Moorea (pronounced Mo-oréa), of which the present paper is the first part, is but a beginning, and I cherish the hope of a return to the islands for a more complete and wider examination than the circumstances of my last visit allowed.

Unfortunately, only Tahiti has been examined by a geologist—Dr. P. Marshall—who located and described the central conduit of the original volcano, and coordinated previous petrological work with his own. The conclusion reached by Dr. Marshall is that "the frequently highly basic character of the volcanic rocks of the central Pacific islands supports the theory that the floor of the Pacific Ocean has its low-lying position as a result of isostatic equilibrium." Daly's theory "that the alkaline rocks are due to the solution of calcium carbonate rock by a basic magma" has no support. Neither Dr. Marshall nor myself have discovered any elevated limestones in Tahiti, thus corroborating Dana and other earlier explorers.†

The action of the sea upon the coasts of these islands is modified by two factors. The tide is very small, amounting to about 16 inches at springs and 6 inches at neaps, as determined by Professor Harrison Smith's tide gauge at Motu Ini, but there are also variations of level in the lagoons due to the water thrown over the edge of the reef. In times of heavy surf the lagoon water may in places rise suddenly several feet above its normal level, making bores in the mouths of streams. I have seen four small bridges on the main road carried upstream by such surges, the position in which they were stranded showing that the wave was 4 or 5 feet above the level of highest tides. At Ventura Inn, near

* Usually written Borabora, but there is no "B" in the Tahitian language. I adopt the corrected spelling given by M. Alexandre Drollet in the *Bulletin de la Société des Etudes Océaniennes*, Papeete, Tahiti, September 1922, p. 23.

† Marshall, P., *Trans. N.Z. Inst.*, 47, 1914, p. 364.

Atiue on the west coast, the water in the lagoon just north of Punaruu Gap may rise suddenly in the mouth of a little brook and rush inland up its sloping bed for 100 yards, to a vertical height of 6 feet, or 3 feet above

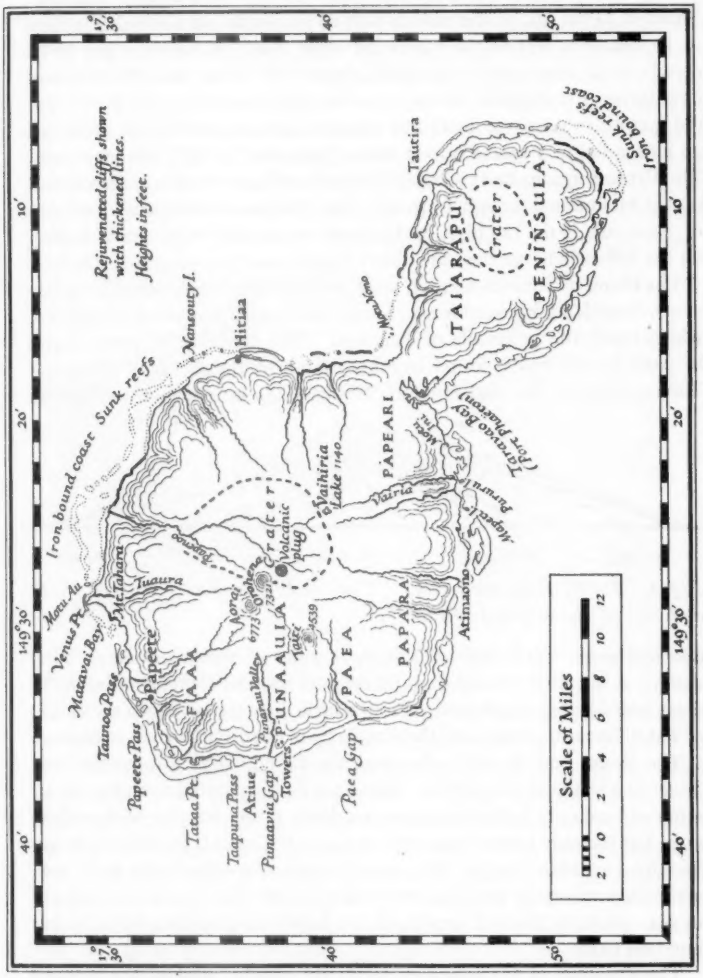


Fig. 1. Tahiti and Taiarapu, from the Admiralty Chart: some detail omitted

the waves' usual highest reach, the water all pouring back after a minute or two to its normal level. The high surf is independent of local winds, always coming up from the south, the effect of storms blowing hundreds of miles away; local winds produce nothing comparable. At these times

the lagoons are full of powerful currents, which stir up the sand from their bottoms even when 60 feet deep.

The rainfall is heavy. The official records, taken at Papeete, the driest part of the island, are, fortunately, supplemented by Professor Harrison Smith at Motu Ini, on the eastern part of the south coast, which I believe to be nearly as wet as the windward coast itself. Crampton has given details from 1901–1905; Setchell gives 77·6 inches for Papeete and 93·8 inches for Papéari in 1923; while from June 1925 to May 1926 the quantities were 120 inches at Papeete and 159 at Papéari. Of this 30 inches fell at Papeete in one week, December 30 to 4 January 1926. The Papéari figures must be multiplied several times to obtain the rainfall on the mountains, though I am sure that Professor Crampton's estimate of 1,020 ins. is far too high, as he seems to assume that rain is falling on the hills whenever they are cloud-capped, as they are almost daily.

The island of Tahiti is a simple cone, without parasitic cones or irregular vents, joined, at its south-east corner, to another but smaller volcano, which forms the peninsula of Taiarapu. The tendency of vents to run in pairs in this way is found in other islands of the group, Raiatea and Tahaa, Huahini Nui and Huahine Iti being similar pairs surrounded by

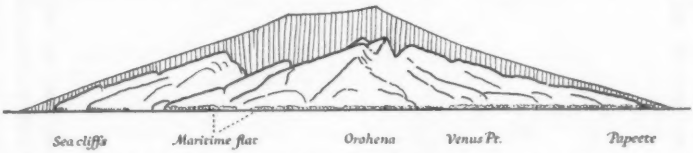


Fig. 2. Tahiti from the north. The shading indicates possible shape and size of the original volcano

one reef each. The cone of Tahiti, in spite of numerous deep radial valleys, is but little altered from its original form in comparison with the older islands, such as Moorea. From a little distance out at sea the ridges of Tahiti blend together, and the simplicity of the original cone reappears.

The slopes end in cliffs all round the island, varying in height from under 100 feet to over 500 feet. These are now separated from the sea by a flat of land only a few feet above sea-level, a tiny fraction of the whole area, but the only land of economic value in the island, the interior being literally a pathless jungle. The shore is generally edged with coral reef, while the surf is seen breaking on the barrier reef half a mile or a mile out to sea. Outside the reef depths of 500 fathoms are found within a few hundred yards.

The drainage of the island is peculiarly simple, most of the streams running in a directly radial course to the sea, only the larger having tributaries at their head. The whole system is youthful, and, for the same reason, the valleys, even the larger, are mere ravines of great depth, like the Tiauru gorge so vividly described by Darwin. In comparison with

these the valleys of the older Society Islands, or of the Marquesas, are broad and open.

The crater walls are represented by a ring of high mountains, of which Orohena, on the north-west, rises to 7321 feet, Aorai, above Papeete, 6773 feet, while the others, to south and east, are between 4000 and 6000 feet high. The immense crater floor has been dissected into a lower mass of hills, of which Dr. Marshall has identified Ahititera, 2700 feet, as the plug in the vent of the volcano. The wildness and apparent irregularity of the mountains of the interior is described by Darwin as the most striking he had seen on his voyage in the *Beagle*, and yet the structure of most is simple. Including Aorai, the second highest, there is a continuous slope on the seaward side, with a great drop inwards to the crater. The " Diadéme " is fantastic enough, the more so when it

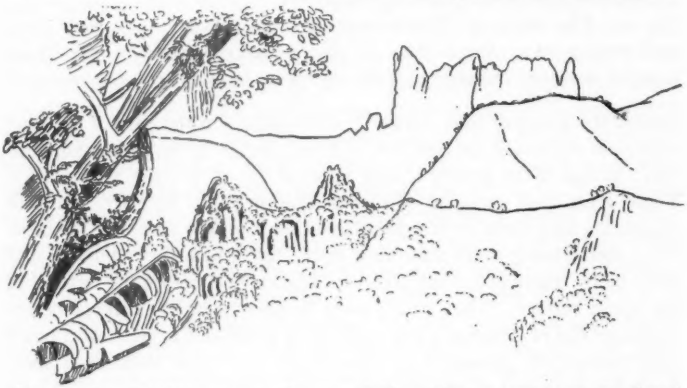


Fig. 3. La Diadéme, 4,500 ft., one of the ridges running up to Aorai. From a photograph by M. L. Gauthier

is discovered that its 1000-feet cliff, with the points which give it its resemblance to a crown, is a wall about three times as high as it is thick, as may be seen when looking up the Punaruu valley from the west coast; and most of the mountains culminate in ridges equally narrow. The regularity of the cone is broken in certain districts, where the slopes descend to the sea at a smaller angle than usual. This is the case in Faaa, the north-west angle of the island, in Papará, the eastern part of Papéari, and in the isthmus of Taravao on the south, and in Hitiaa on the east. In Faaa this is due to a long lava flow which has extended the whole of this corner of the island farther into the ocean; but in the other cases the abnormalities are due to earth movements, shown by the great precipitous rock walls, which bound them on one side or the other. In the low slopes of Hitiaa, the visible rock strata show that the depression is in the actual formation, not the result of erosion for instance, and the high rock wall which bounds the normal slopes is seen behind.

In all these cases it is particularly interesting to note how the reefs follow the island's structure, the off-lying angle in the reefs of Faaa and the bulgings off Atimaono and other parts of the south coast being particularly remarkable. Either the reefs grew up after the main features of the island had reached their present state, or these earth movements

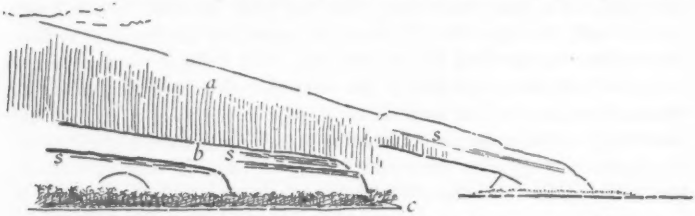


Fig. 4. The slopes of Tahiti seen from off Hitiaa. (a) Steep rock-wall with normal slope to sea. (b) Ridge with gentler slope. (s) Strata parallel to slopes, showing that the difference in the angles is structural

carried the growing reefs outwards with them. In the case of the long unbroken reef round the lava flow of Faaa I incline to the former supposition; in that of the greatly broken series of the south coast, to the latter. These great reefs must be of considerable geologic age, Dr. Marshall suggesting that those of Mangaia have been forming since the Miocene. They are certainly older than most of the flat, which they underlie, and show many traces of having been at a higher level before the last fall of the ocean surface. They would seem to have been in existence before the broad flat of Atimaono was made, as it is difficult to see how it could exist without the protection of coral reefs; the reefs themselves show much breaking and re-cementation.

All the lower slopes of the mountains are covered with a hard red clay,

Fig. 5. The lower slopes of the south coast near the mouth of the Vairia. (a) Sharp-edged ridge broadening into small plateau. (b) Rounded head of a short valley. (c) Old sea-cliffs truncating the ridges: below, maritime flat, deltas and reefs

laterite, which frequently appears, especially near Papeete, as bright-red bare patches in the bracken-like fern which covers it. This is the

result of the decay of basaltic lavas, and this clay, matted together by the rhizomes of the *Gleichenia* (*Dicranopteris*) fern, is highly resistent to erosion, so that many parts of these slopes are not far below the original level at which they were formed. The structure is always the same, ridge after ridge, razor-backed or broad-topped, regular or with projecting saw teeth, descending all at the same angle to the cliffs, where they are cut off by steep slopes to the sea-level flat. Little hard rock is to be found, generally none at all on the tops and upper parts of the ridges, but across the valleys precipices of black rock are visible.

The height at which the mountain flora begins varies with the exposure to the trade winds and consequent differences in the rainfall. On the ridges above Papeete the change takes place at about 1500 feet; on the south coast not much over 500 feet; while above Hitiaa, on the east, at 100 or 200 feet above the sea. On these wetter sides of the island members of the mountain flora, such as *Angiopteris*, come down to sea-level, and epiphytic ferns cover the trees by the seashore, naturally reaching much lower levels in the valleys than on the adjacent ridges. Their distribution is thus more dependent on humidity than temperature.* The views from these slopes are truly wonderful; the white line of surf divides the many-coloured reefs from the blue-black ocean depths, the lagoons, passages between reefs, submerged flats, and the passes connecting the former with the ocean are all as clear as on the chart; reef islets beyond the palm-covered maritime flat, river deltas, all combine to make a picture which the most experienced traveller will remember and find peculiarly full of interest. From above Papeete the next island, Moorea (Eimeo) is seen across the water, with its surrounding flat, set, as Darwin describes it, as a picture in its frame, within the white circle of its barrier reef, while on the far horizon a dim line represents the trees on the atoll of Tetearoa.

The larger valleys of Tahiti may be known from descriptions of that of Vaihiria on the south and Fautaua on the north-west. The Tuauru gorge above Point Venus has been inimitably described by Darwin, whose account of Tahiti, though so short, is the best yet written. The Vaihiria valley holds at its head the only lake in Tahiti. On entering the valley from the maritime plain one first traverses a small flat, half cultivated with coconuts and vanilla. These flat-bottomed valley mouths may indicate subsidence and drowning, though the same form results from the action of the stream at constant sea-level, if its mouth is partially blocked by detritus, or by an incipient coral reef. Two of the largest flats, those of the " Reine " Valley near Papeete, and of the Punaruu on the west coast, are in valleys with constricted mouths, and the former may have been a fresh-water lake. Pending definite evidence by boring or well digging, and in view of the absence of bays from the Tahitian

* For a full description of the flora of Tahiti see Setchell, W. A., ' Phytogeographical Notes on Tahiti,' Univ. of California publications in Botany 12, No. 7, 1926. Univ. of California Press.

coast, it is more reasonable to hold that the flats have been made by the stream at constant level than to postulate a deep subsidence, for which there is no other evidence. The existence of barrier reefs does not provide such evidence, for the lagoon cannot be accounted for by the drowning of the land and the upgrowth of a second barrier reef.*

The flat is soon passed, and the rest of the valley is a mere ravine, with just room for the stream and little flats beside it. The trail is nowadays traced with difficulty, though Tyerman, in 1821, found evidence that this route over the mountains to Papenoo and the north coast was used to a considerable extent. The lower part of the valley is blocked by a tangle of *Hibiscus tiliaceus*, the habit of which is for the main trunk to bend over to the earth again, forming an arch 4 feet high or so, from which straight branches spring upwards 30 feet into the air. The little flats by the stream, if of gravel, are open expanses of *Tradescantia*, where soil occurs are thickets of " Opuhi " (*Amomum*), through which almost dark tunnels are cut. The sides of the ravine are covered to their summits with a rather nondescript bush, large trees such as the Mapé (*Inocarpus*) being infrequent. The general uniformity is broken here and there by patches of " Fei," the wild plantain, tree ferns or the great ground fern, *Angiopteris ;* spots of colour are afforded by an occasional orange tree literally covered with golden fruit, and in one place by a bush of scarlet hibiscus. Every tree is covered with epiphytes, ferns, mosses, and selaginellas. Orchids are common, but of the most abundant species I have seen the flower but once. In the higher reaches of the valley, where, even after a dry spell in the drier season of the year, everything is soaking wet, every twig is covered by a bright green moss, spreading from its supports into little sheets of transparent emerald, and filmy ferns do not need the spray of waterfalls. The impression of vigour of plant-life is stronger than what I recollect in the forests of Panama.

The valley rises regularly ; the stream has an even, rapid flow, unbroken by waterfalls until the head of the valley is reached ; also there are no tributary streams and no side valleys ; black streaks through the vegetation of the walls of the ravine show where water-slides exist after rain, but there is no cutting back, not even the beginnings of lateral ravines. In the higher part of the valley buttresses project from either side, so that the stream makes several sharp bends and the view up and down the stream seems to be bounded by impassable precipices. This lower valley ends abruptly, and the scarcely visible trail ascends a buttress on the right, one of those climbs which, to paraphrase Darwin, I could never be persuaded to undertake, were not the dangers hidden by the density of the vegetation. After a climb of about 200 feet we emerged upon a level expanse of big angular stones, hidden, of course, in the usual dense jungle, which is the top of the dam that holds back the lake. On the right, towering above the dam, is the first precipice yet seen so truly

* See *Nature*, " Barrier Reefs as an Indication of Subsidence," vol. 120, p. 11, 1927.

vertical as to be nearly bare of vegetation, and this gives the key to the origin of the part of the dam upon which we stand, a landslide filling half the width of the valley. As we proceed the dam is completed by a much larger landslide from the opposite wall of the valley, and the oft-repeated statement that the cuplike hollow in which the lake lies is an extinct crater is clearly without foundation.

The lake itself, a typical mountain tarn about half a mile across, is about 100 feet below the level of the top of the dam, of which height about half appears to be the limit of the highest floods. This level is very distinctly marked by a change in the vegetation all round the tarn, the complex dark green tangle of bushes, ferns, *Freycinetia*, etc., which covers the higher part suddenly giving place to an open expanse of grass-green herbaceous *Tradescantia*, among which are bushes of guava, spaced out as though in an orchard. At an intermediate level is another line in this vegetation marking a high-water level more frequently attained. There is never any overflow from the dam, for there are subterranean outlets, one of which can be heard roaring below by placing the ear to certain rocks on the shore. The tarn was sounded by an expedition from the *Challenger*, and its depth, reputed unfathomable, found to be 60 feet.*

The head of the valley, at the sides of and beyond the tarn, is a cup of great cliffs between 2000 and 3000 feet high, the lower parts of which are supported by a series of great sloping buttresses, all flat-topped and all of the same height; the origin of this remarkable feature I have been unable to discover. The landslides which form the dam are particularly interesting, and may have importance in illustrating peculiar features of the mountains of Tahiti. The smaller one on the east has carried with it two great rocks, a pyramid and a prism in shape, which stand upright above the more broken material in which their bases are embedded. On the other side, where the landslip forms not only half the dam but the western shores of the tarn, the whole mountain has been split, a knife-edged hill separating from the main mass. How often the knife-edged ridges, the characteristic feature of Tahitian mountains, have been formed in this way, it would be interesting to know.

The fabulous monsters with large yellow ears, reported to the *Challenger* naturalists, still retain their reputation. The "bright yellow ears" suggested that these big eels might be in their breeding dress, as in the *Cloaca maxima* of Rome, where their passage to the sea is blocked, but the two specimens we obtained had no trace of yellow even on the fins (which are, of course, the ears of popular report). They were about 4 feet long and cooked in the Polynesian earth oven were delicious. Three joints of bamboo were packed with their flesh for cooking, of which two fed a party of seven, for two meals, and the third was carried home. The water of the tarn is distinctly green, though transparent to a depth

* Dr. Wilder found maximum depth 33 metres (*Bull. Soc. Etudes Océaniennes*, Papeete, Dec. 1927).

of a fathom or two, the colour being enhanced by a coating of conferva over the bottom. No other alga or water-plant was seen, but along the west shore were great quantities of the freshwater polyzoon " zoophyte " *Plumatella* in both creeping and upright forms. The latter made masses up to 9 inches thick, which gave off quantities of bubbles when handled, and in them lived extraordinary numbers of a small oligochaet worm, fewer of a much larger species, and quantities of snails. This larger worm was also found when digging the oven, the humus, like the vegetation above it, being hardly less wet than the tarn itself.

The Fautaua River is the main stream of the north-west sector of the island. Its valley differs from the preceding in the prominance of hard rock in its walls, which, in the higher reaches, form high vertical precipices. For the first few miles the sides are the usual very steep slopes, covered with a uniform thicket of the lantana pest, no red earth being visible anywhere. Higher up are rock buttresses standing out at right angles to the slopes and frequently quite wall-like in their narrowness. Only two exposures of columnar basalt were seen, the mass of the rock being the usual breccia ; the lower consists of columns which have their bases bent backwards, *i.e.* up the valley. At and beyond the fork of the stream the valley is a mere gorge of great depth, with most of its rock walls vertical, the ridge between the two streams running up to a pinnacle with a perpendicular drop on its south-west side, making a quite fantastic, but characteristic, feature of Tahitian scenery. Into this gorge the stream descends as a high waterfall, which at first suggests a hanging valley above it, but from what could be seen of the upper gorges it would appear that the continuity is not so greatly interrupted, the height of the fall, though several hundred feet, not being large in proportion to the total depth which has been excavated.

Another common type of Tahitian valleys ends in a half-cup of black cliff with a thin white waterfall several hundred feet high, generally only visible after rain. This is a feature of the island scenery which seems to have received more attention from the romantic than the scientific writers, and it is difficult to explain. There are cases where the usual explanations obviously fail, such as a little valley in the lower clay slopes above Papéari, which I have examined. The cliff at the head of the valley is below a little plateau, a remnant of the original volcanic slope, surrounded by deep valleys. There is therefore no catchment area for a stream, nor is there any trace of a stream bed possibly older than the surrounding valleys. There is no bed of harder rock on the surface, rather the reverse is the case. In short, there are visible no means by which the valley could have been excavated, just as the waterfalls noted above are totally inadequate to the carving of the semicircle of cliffs over which they fall. This puzzling physiography appears to be the result of rock structure peculiar to volcanoes which have reached this state of decay in the tropics, viz. the alternation of lava sheets of very different strengths,

some of which have decayed more or less into clay. On the small scale these changes are illustrated by photographs (not reproduced), which show how irregularly they occur and the obvious instability of the resulting cliff. A third example is provided by a road cutting a mile past the south end of the Faaa district, which exposes 60 feet of hard basalt with a band of red clay at the road-level. A consequence of these varying metamorphoses is that quite a considerable proportion of the drainage of Tahiti is now subterranean, reappearing at the foot of the cliffs, on the seashore, or even in the lagoons, as copious springs. In the Faaa region and above Papawa this has gone so far that the valleys are now left dry, even without a stream bed to carry off the water in the wet season; indeed there is only one small stream in the whole district which carries water for most of the year. Practically the whole normal drainage of this large district is by springs, and much of it in even so rainy a district as Papéari.

On the other side of Papeete the Papawa stream is another remarkable example. From its shortness and breadth it would be expected to be pond-like or tidal, whereas it is a stream 15 to 20 yards wide with a fairly rapid flow, even where it passes through swamps and beds of tall reeds. On penetrating to its source we find this to be a series of large springs along the foot of the old cliffs, some rising as domes of water on the surface of pools, one falling from 2 or 3 feet above the bottom of the rock. The valleys opening through the cliffs are now dry, like most of those in Faaa.

It appears then that the subterranean drainage, and landslides resulting therefrom, have had a large share in the production of the topographic features specially characteristic of these islands, knife-edged mountains, ridges and high cliffs at the heads of valleys, with slender waterfalls after rains.

In Faaa, as has been already stated, the slope of the cone is at a low angle, thrusting out the whole of this corner of the island into the ocean, and making the whole district different from the normal structure of the island. As this district is the nearest to Papeete on the west, it is the best known to most visitors, to whom, without acquaintance with the rest of the island, its peculiarities cannot be remarkable. These are as follows: the road passes over undulating ground, streams are infrequent, in fact there are only two, of which one is generally dry, coconut plantations extend for some way up the slopes above the sea, and there are no conspicuous cliffs bounding the flat inland. The seashore is of red mud, thickly covered with freshwater reeds, which grow out into the open lagoon as if that were a lake instead of the sea. That these features, all but the last so commonplace, should be quite abnormal in Tahiti, emphasizes the peculiar physiography of the island, where the shore road practically always runs on a level flat, rarely more than a few feet above sea-level, with slight rises over alluvial fans at some of the valley mouths.

streams are frequent (and also broken bridges), and cultivation ends abruptly at the foot of conspicuous inland cliffs. Through much of this district of Faaa there is no true maritime flat, the lower parts of the volcanic slopes simulating it; where it does occur the flat is very low, and composed of a mixture of red mud with coral fragments, the latter constituent increasing seawards until at the ends of the promontories, such as Piafau and Tehiri Islet (which is really part of the maritime flat), there are beaches of pure coral débris. The growth of reeds (*Typha domingensis*) in the open lagoon is a truly extraordinary phenomenon. It occurs only in one other place in the circumference of the island, a small patch in a little inlet east of Motu Ini on the south coast. In Faaa the beds are numerous and large, and extend out into the lagoon fully exposed to the tide. The explanation is found in the peculiar structure and drainage of the district described above, bands of soft clay, through which water is continually seeping, being "squeezed out" along the shore. In this the reeds, and a little inland of them other marsh plants, make a sponge with their roots, which are thus always supplied with fresh water.

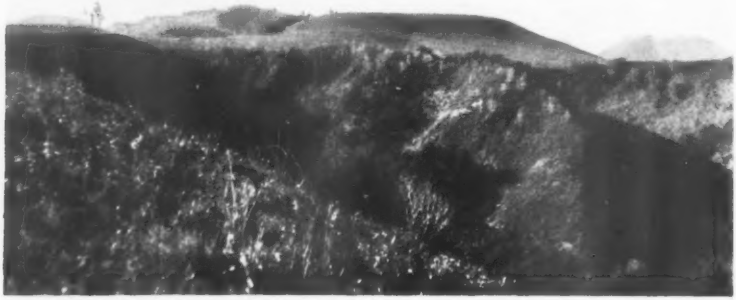
Taravao Bay, the only bay in Tahiti and Taiarapu, is obviously formed by inclusion between them and the isthmus which connects them at its head. (It is called "Port Phaëton" on the chart, but *this* is the Taravao Bay of the natives.) It is narrowed into a valley-like shape by the broad reefs at its mouth, and the wide flats of land which have accumulated upon them. Its outline, as shown on the chart, with the series of rounded side bays which open off it, is peculiar enough, but becomes more so when the others, which being dry were of no interest to the chart maker, are also considered. Each is surrounded by little cliffs of red clay, 30 to 50 feet high, the origin of which is obviously not by marine erosion, past or present, but by the action of subterranean drainage and landslides, several of which are conspicuous, as red patches among the green, at the present time. The formation of the isthmus is complicated, but in the main it is due to an abnormally long lava flow from the smaller cone, Taiarapu, meeting one of the down-faulted areas of Tahiti mentioned above. On its eastern side is an addition of old coral beaches, not appreciably above storm-level. The old marine cliffs of the east coast turn inland at the isthmus, but are not continuous with those which cross the Tahitian side of the neck, which are a fault scarp. The conspicuous little red hill of Farei, on the west side of the long slope from Taiarapu, is unique in its isolation, and may be a relic of a small volcanic vent.

Cliffs of marine origin, but now separated from the sea by the maritime flat, practically surround the island, being absent only for short stretches of the Faaa district, near Papeete, and in the isthmus of Taravao. Wherever they have not been rejuvenated by the return of the sea they have been altered by subaerial denudation to a steep slope, and by rock

The west coast of Tahiti, showing remnant of volcano and maritime flat

The island of Moorea from Atine: its rugged outline and open valleys show it to be much older than Tahiti

The north-east side of Tahara Head, undermined by the sea



The cliffed head of a valley on lower slopes of Papeari, with small plateau above

Looking seaward from plateau in photograph above

decay to a smooth surface of clay and rubble, hard rock scarcely ever appearing. The variations in height of these cliffs show clearly how much greater has been the cutting effect of the surf from the south, than that of the waves raised by local winds. For instance, Taiarapu, seen from one of the bluffs above Taravao Bay, shows how the height of the cliffs increases towards the south and west, and réaches a maximum of about 1000 feet on the lee side of Taiarapu peninsula. Similarly, to the north of Tahiti, the cliffs first become of considerable height in passing down the west coast after the Punaruu river is crossed, where they are about 200 feet high, increasing southwards to over 500 feet, remaining high all along the south coast until Taiarapu gives shelter, and the topography towards the isthmus is complicated by earth movements. Along this south coast, particularly just west of the Paparà subsidence at the south-west corner of the island, are high cliffs of bare black rock, higher than 500 feet in the former case. These are not due simply to marine erosion, but owe their present form, and much of their height, to the causes which have formed similar cliffs in the inland mountains. This is shown by the occurrence of spurs below them which have been truncated to the normal height of the sea-cliffs, and which would necessarily have been entirely removed before marine action could have cut the higher cliffs behind them. This occurrence of subaerially formed rock faces in the line of the old marine cliffs is conspicuous again on the north coast of Taiarapu, especially just north of the long point of Tautira.

The cliffs of the east, or windward, coast are not particularly high, generally about the same as those of the eastern part of the northern. They are highest on the south, where the absence of the reefs for short distances has led to their rejuvenation, and here they are about the same height as the similar cliffs of the north-east. These rejuvenated cliffs are particularly interesting. We find them wherever reefs are absent, or submerged: in Matavai Bay, at intervals eastwards thence along the north-east coast, opposite the two wide gaps in the southern part of the east coast, and on the southern point of Taiarapu peninsula. On the long stretch of ironbound coast of the north-east we feel that we have gone back to the Marquesas. There is no flat (and consequently no inhabitants), and the ocean waves break violently against the shore of black rocks, since the barrier reef lies under about 5 fathoms of water. Along the foot of the vertical cliffs of basalt is a very distinct shelf, about 6 feet above the sea, showing that the last change of level has been one of emergence. As so many islands of the Pacific are bordered by a similar shelf, wherever the rock has been sufficiently hard to preserve it, *e.g.* the Marquesas, Rapa, Samoa, to mention only a few points on a great triangle, it is evident that a fall of the ocean-level has occurred and not a series of local elevations.* On the southern part of the east coast the cliffs are part of hard basalt, part of the commoner brecciated lava, and

* Daly, *Carnegie Institute of Washington*, vol. 19, 1924 (Mayor Memorial volume).

here we find the shelf differs in height with the hardness of the rock, that in the softer material being only just above sea-level.

There are no capes of more resistent rock breaking the general uniformity of the coast-line. Of the four prominent projections, the two larger, Venus Point and Tautira, are alluvial, the other two, Tahara and Tataa points, are of soft ash rock capped by red clay, and both are certainly original, not vestigial structures. Tahara Head projects into Matavai Bay, where the barrier reefs do not reach the surface, and is therefore exposed to ocean waves, and is undergoing degradation. The north-east side of the cape is exposed to no more wave action than is the north and west, so this factor does not account for the complete difference in their characters. The former is a vertical yellow cliff with small caves at sea-level, no trace of a shelf or any coral growth at its base, obviously the whole sloughing away rapidly. To the south-west the cliffs are, though of the same material, dark in colour and carry a certain amount of vegetation, and there is a fairly broad shelf at their base protected along its seaward margin by a thick coating of corals and lithothamnia. The

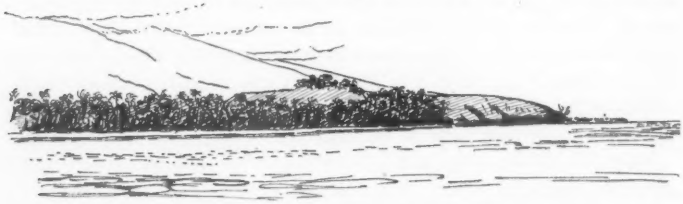


Fig. 6. *Tataa Point in Faaa Lagoon*

difference is largely, if not entirely, due to the impact of sand carried westwards against the cliff, which renders the protective growth of corals impossible. Tataa Point, projecting into Faaa lagoon, is similar, but much smaller in height and area, and the covering of red clay does not extend to the sea. The cliff at its end, which is only about 20 feet high, owes its origin to lagoon wavelets, but more especially to currents. The rock shelf at its base runs out into the lagoon, at low water-level, and though corals are abundant, no lithothamnian crust is ever found in the water of enclosed lagoons to which the surf does not penetrate.

Behind Papeete, as in the clays of the low slopes of Faaa, the cliffs are traceable only as banks 20 to 50 feet high, and are not always visible at all, surrounding a bay in the hills, sharply marked off on the west by higher cliffs of harder rock between it and the slopes of Faaa. The head of the bay appears to have been always devoid of reefs, but on either side they are well developed, extending to a distance seawards; that on the east is covered with coral beach material and forms Fareute Point. To seaward the barrier reef goes right across, enclosing the harbour, its course unaltered by the indentation of the coast-line.

All the off-lying islets are stated by Agassiz to be " volcanic outliers," such as would be expected off a coast eroded to the extent shown by considerable cliffs, but no lava rocks project through the reefs, like the granite of the Seychelles illustrated by Gardiner in the *Journal* in 1906, or the Cockscomb and other rocks of the coast of Tutuila in Samoa, have been found anywhere round the three islands Tahiti, Taiarapu, and Moorea. The reef islets are of purely coral formation, and placed in just those positions on the reefs where coral débris would be expected to be thrown up, namely, near the ends of reefs bordering, but within, the mouths of passes. I have examined practically all, but describe only those which Agassiz particularly refers to.

Motu Uta, in Papeete harbour, is all of coral and shell sand, the black rocks upon it being the remains of an old fort, the pitiful attempt of the Tahitians to maintain their independence. Motu Au, off the east end of Point Venus (" Brander's Island "), is made entirely of coral clinkers, for the most part *Pocillopora*, in this and in its height corresponding to its exposed position. There is an infinitesimal proportion of basaltic pebbles upon it, such as are present in and upon all the reefs, but the appearance of higher ground is due only to a windswept clump of púaro bushes (*Hibiscus tiliaceas*), forming a solid-looking mass. Motu Tehiri, off the shore of Faaa, is not strictly a reef islet, but a portion of the low maritime flat, separated from the mainland by a strait of water a few inches deep. It is strictly comparable with the next points to the north and south, in formation and constitution, being made of alluvium, then alluvium with coral, and finally pure coral seawards, ending in a low beach of coral sand. In correspondence with the general decay of the reefs, and the washing away of the maritime flats, all the reef islets are decreasing in size. Generally this is clear from examination of their beaches and the surrounding reefs, but on one of the two islets off Papéari, where there is little direct evidence of removal, a native who was with me pointed out a former extension of considerable size, and stated that a little sandbank to the east had once borne a coco palm. Half of the islet in Papeete harbour was swept away in a storm accompanied by a high tidal level in 1906, and there are no signs of its rebuilding. The most conspicuous change is that in the four islets of the east coast off Hitiaa, of which the southernmost, shown on the chart of 1875, no longer exists at all, not even as a bank awash ; the next is a wreck of bare coral shingle, bearing four dying trees (three Pandanus and one " tamanu ") ; the third is of fair size with a number of trees, but many awash or fallen into the sea, while Nansouty islet, the largest, is thickly covered with trees, and shows little sign of destruction. The names of all four islets are known, including that of the southern islet, as it only disappeared when my host was a boy—say thirty years ago—and an older man told me there were trees on all four islets, but no palms on the then existing southernmost. It is from the western, or inner, side that the present

southern wrecked islet is being removed, leaving a little cliff, along the top of which are the four surviving trees, without a scrap of undergrowth. On the eastern, or outer, side the top of the beach is black, a sign that it has been undisturbed for many years. This islet is made entirely of coral shingle, principally *Pocillopora* branches with the slab-like stocks of *Acropora spp.* at a lower level, while the other two on the north are of coral sand browned by humus. The destruction of this islet is evidently due to the degradation of the reef end. The chart of 1875 indicates a portion of reef to the north of the islet, which is now so low that the waves sweep right round the islet, and make a slight sea to the south of it even in calm weather. This islet, even more than the others, affords clear proof that the Tahitian reefs are no longer growing but being destroyed.

The losses of land from the encircling reef were probably more extensive than that which may be estimated from the evidence now available, and Tahiti may have been girdled by reef islands, as are some of the other Society Islands still. The east coast of Huahine Island is almost completely surrounded by reef islets, and one of those off Moorea is joined to the mainland at both ends. The maritime flat of Tahiti was once far more extensive than it is now, and the addition of coral islets would have made the habitable portion of Tahiti several times larger, and so provided a country for a population sufficiently large for the evolution of a distinctive Tahitian culture. It is particularly to be noted that the present reef islets of Tahiti do not correspond to those on the *edges* of reefs, such as those of Moorea or Huahine, nor with those of atolls, with which the latter are homologous.

The existence of the maritime flat between the mountains and the sea is one of the most striking differences from the Marquesas, in which each island is divided into isolated valleys. The absence of communication between them leads to constant intertribal war, while in the ease of communication along the coastal flat, and by canoe in the lagoon, the Tahitians grew up as one people, becoming a mild and civilized race in comparison with the fierce Marquesans. Again, as the Polynesian food supply is mainly from trees, the staples being the breadfruit and banana, which on the naturally irrigated flat can never suffer seriously from drought, the famines which periodically threatened the Marquesans with the end of their world did not affect the Tahitians in the same terrifying way. It is possible that to this is due the fact that, while the Marquesans were the most inveterate cannibals in the Pacific, the charge has never been proved against the old Tahitians.

The maritime flat is interesting not only as the home of the whole of the present population, and the only land of economic value, but from its history and formation. Its foundations were laid when, the ocean-level being higher, the sea beat against the cliffs, and the coral reefs were forming upon the detritus which made the shallow sea round the island. These reefs were at a higher level than the present, and as the water

receded they were generally cut down to the new sea-level. As traces of this process are to be found not only where the coral foundation of the flat is laid bare by streams, but also on the edge of the barrier reef a mile or so out to sea, it is apparent that the whole width of the reef was formed at this time, and that, in spite of quite abundant coral growth, nothing has been added since. Lines of beach deposits were thrown up on the reefs enclosing swamps between them and the cliffs, of which large examples remain on the west coast, and probably there were islands farther out, as there certainly were in Moorea.

The fall of the sea-level now permitted the extension of local accumulations upon these foundations, forming a continuous broad flat, much of which was thus drained and fit for the growth of trees and the habitations

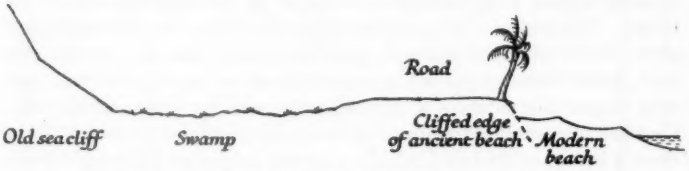


Fig. 7. Old and modern beaches of the north coast

of man. Deltas spread seawards on the reefs, but it is to be observed that, so recent is this retreat of the sea, that in nearly all cases the edge of the underlying reef is still visible. Some rivers are now carrying heavy alluvium to the shore, notably the Punaruu and Papenoo, while others, such as the Fautana and the rivers of the south coast, drop great banks of boulders in the valley mouths, and carry on to the sea nothing but sand and fine gravel. In other places the fall of the sea laid bare lagoon shallows of small coral fragments mingled with black sand and red mud. The latter is confined to the Faaa district and has been already referred to; the former may be seen in the district of Patutoa (the word means "coral built") to the east of Papeete; also on the west side of the harbour, and extensively on the southern part of the east coast. These deposits are always low-lying, not more than 2 or 3 feet above normal high tide, and the coral remains unconsolidated except where beach sandstone is formed. The only higher coral formations are part of the old beach between Punaruu and Pa'ea on the west coast, and an area of larger pieces of coral on the east side of the isthmus of Taravao; but this was thrown up under present conditions, after the barrier reef off this coast was eroded to a submarine bank. This comparative scarcity of coral on the surface of the flat in the modern beaches is in marked contrast to Moorea. In this smaller and older island erosion has slowed down to a small fraction of the rate at which it is proceeding in Tahiti, with consequent increase in coral growth in the lagoons, the result being that practically all shores, and most of the flat, are of coral sand.

Some of the most conspicuous additions to the flat are alluvial fans disproportionately large for the valleys from which they issue, and which have resulted probably from catastrophic floods and landslides. A small but clear example forms the dry section of the swampy south coast upon which Keane's Hotel is built, into which the trivial stream of the valley is cutting a miniature ravine. Another, near the north-west corner of Moorea, is so recent that its boulders are not yet covered with vegetation.

Another possible addition to the land, wind-blown sand, occurs but once in all Tahiti, Taiarapu, and Moorea. On the east side of Point Venus is a line of high sandhills, covered with vegetation and palms; they are peculiar in making one single line, which is steep on both sides. The extension seaward of these structures is now inhibited, and the flat is being eroded away through nine-tenths of the circumference of the island. The evidence of rapid destruction shown by the undermining of trees and the cliffing of shores is generally so clear that he who runs may read, but in other places where beaches seem to afford protection, and even suggest aggradation, a short search reveals the same ruthless loss; the roots of casuarina trees may be found in position of growth halfway down a beach, or the beach may be a merely temporary accretion against the cliffed edge of the older deposit. The largest illustration of the temporary nature of such beaches is given by the road on the north coast, which is continually being remade farther inland. Where it crosses the face of the Tapahi cliff it was carried away by the storm in which I arrived at the island; it was recut in the cliff and protected by a concrete wall. This appeared superfluous, for the sea immediately threw up a beach against it, yet the last time I passed, the beach had gone and the wall was collapsing.

The recession of the reefs, and the opening and development of the lagoons in the once continuous reef, are the factors which have resulted in this change from growth to destruction. Where the reefs have been cut down to submarine banks, as noted in describing the cliffs, patches of both flat and shore reefs exist as remnants, showing that in former times these were developed here as on the rest of the island's coast.

All the rivers which enter the sea near passes have beach dams thrown across their mouths. The Fautaua river, the principal stream of the north-west quadrant of the island, is a remarkable example. With the next stream to the east it opens into Taunoa harbour at the one point where a little shore reef projects, the rest of the bay being bordered by old beach deposits, that to the east of the river mouths being especially well developed, and the site of houses and plantations. Starting from the west end of the bay four mouths of the stream are passed, now elongated ponds covered with lilies and reeds; then comes the little reef where the beach dam is interrupted and the streams reach the sea; finally the higher beach with swamp behind it and another old stream channel which may carry water in floods. A third stream enters the sea

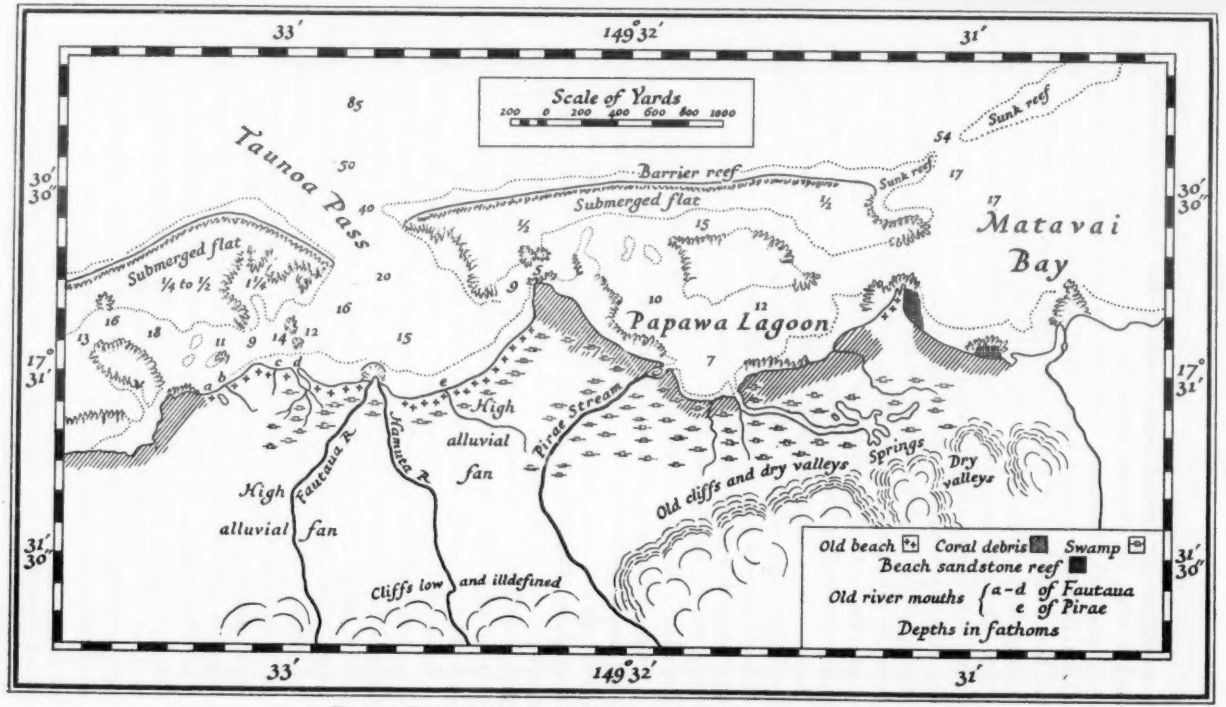


Fig. 8. The mouth of the Fautaua River, Taunoa Harbour

just beyond the eastern point. Clearly the mouth of the Fautaua has been pushed farther and farther east by the damming of successive mouths, while the Hamuta stream has been shifted west, until they met at the point where the little shore reef, by preventing beach formation, allowed them to flow into the sea without hindrance. The eastern stream has been pushed out of the bay altogether. It may be noted the effect of these rivers on this reef, and the growth of coral on its edge have been slight. These streams, like the Punaruu and Papenoo, do not form projecting deltas, their alluvium being carried along the coast by currents. The Papenoo delta, for instance, is cut off and spread out westwards, forming the last inhabited land before the ironbound coast; that it is supported by pre-existing reefs is shown by the projection of dead remnants at its western end. Similarly the alluvium of the Punaruu is carried northwards until it impinges upon the north side of the Punaruu gap. Here it forms a trivial extension of the flat, but this is only temporary, for the reef upon which it is founded is being destroyed. The delta of Motu Ini extends over an unbroken reef, but only for a certain distance, after which its sand is swept westwards as a long bar, the Motu or Island. When this reaches the west side of the reef it spills over into the lagoon, into which it has extended the island but a very short distance.

Yet these examples did not satisfy me that in all cases the deltas were later formations than the reefs, and it seemed possible that certain on the south coast, which project into calm lagoons, might show reefs founded upon deltas older than themselves. That of the Vairia, for instance, is tending to fill in the lagoon, as shown by shallow flats of halophilous grass from which slopes of black sand descend into the lagoon. Yet here, as in all other cases, there is no doubt that the delta is supported upon reefs older than itself, and would not exist without them.

The whole history of the flat, and therefore of human life upon Tahiti, is bound up with the life of the coral organisms, the failure of which has doomed this remnant of the Polynesian race. Where the process has gone farthest, on the north-east coast, the island is desert, but in many other parts the flat is reduced to a mere fringe of palms, almost without human habitations. This is the final fate of the island, to become impossible as the home of so easy-going a race as the Tahitians, who even now are being rapidly supplanted by the hardier Chinese, who alone have the energy to cultivate the barren slopes above the cliffs, and some of the less forbidding valleys. In times past, as shown by recent explorations by Mr. K. P. Emory, of the Honolulu Museum, certain inland valleys were occupied by Polynesians of an allied but distinct culture. They have left twelve temples in the great central Papenoo Valley, but their numbers must always have been small, most of the valleys being too inhospitable for large populations. From the commercial standpoint the value of the island depends on the maritime flats, its present main export is copra, and coconuts will not grow on the uplands. Vanilla is cultivated in the

Fig. 9. *The mouth of the Punaruu river, showing gap in reef*

valleys, a somewhat precarious crop, which has to face the competition of chemical substitutes. The pearl shell exported from Papeete is not a local product, but comes from the Tuamotu atolls.

Any statement as to the present condition of the natives may lead to controversy, but it is enough to say that there are at present about 5000 natives and half-castes altogether, of whom one-third live in Papeete. The proportion of half-castes is very high, some estimates put the pure-blooded natives remaining at under a hundred; but the great majority of half-castes, who are not in the least ashamed of their mixed blood, and who speak Tahitian as their mother tongue, live in the Polynesian way. The estimates of the population made by the first visitors may have been excessive (Cook's certainly was), but the decrease since the downfall of the native culture, 112 years ago, has been tremendous. The influenza epidemic of 1918 carried off 4000 people from the scanty population, leaving the figures given above. The greatest direct cause of the decline appears to have been tuberculosis, venereal disease and alcoholism aiding and often directly leading to tubercle. Indirectly the change of habits, of food, of clothing, of housing and of relaxation have been very potent. The staples of the old diet were breadfruit, taro, and plantains, with occasionally fish, pork, and chickens, coconuts providing drink and sauces. With sheltered water always available and fishing regarded as a sport as well as food supply, it would be supposed that fish was a major part of the diet, but it appears that, except at certain seasons, the supply was always below the demand, as it is now. All coral lagoons are poorly supplied with fish food, and therefore fish are scarce; most fishing is done outside the reefs, largely by night, when the rise and fall of the swell shows and eclipses the lights of the canoes. In the old days these lights were flaming bundles of dry palm leaves; they are still used, but far more generally paraffin hurricane lamps, and even petrol incandescent mantles. The catches are poor. I cannot imagine a starving native of the Red Sea putting out at sunset and returning in the chilly dawn for such a result. Nor would he search every yard of the reef for shellfish—things he never touches until his pay for three months ahead is all spent.

Nowadays the Tahitian sells his fish and coconuts and buys bully beef, tinned herrings, rice, and the utterly unwholesome clothing of Europe. He boards up the walls of his house, and roofs it with unlined tin. So he loses his teeth and gains tubercle. The universal planting of coconuts has changed the appearance of Tahiti. The woods of breadfruit, which so impressed Darwin, no longer exist, and a large proportion of the remaining trees have been stunted and deformed by horses gnawing their bark. Going farther back still, the native plantations seemed to the European observer a mere natural wood, the only part evidently artificial being the plantations of young "paper mulberries" which were cut down every two or three years in order that the bark might be

Beach of Pocillopora on Motu Au: Orohena beyond

"Nansouty" islet looking south to the second of three islets off Hitiaa

A wrecked islet off Hitiaa from the lagoon side: cliff of Pocillopora branches above, Acropora below

Coast erosion undermining palms on Mataiea

The cutting away of the old beach on the west coast near Atine

The high cliffs of the south-west angle of Tahiti

beaten into "tappa" cloth. Such plantations are, of course, no longer seen.

Commercially and socially Tahiti is really a trifling affair. Its splendid reef-bound harbours exist for nothing, not even for coastwise traffic. Papeete itself would have no existence as part of Tahiti, it belongs to, and is, the capital of the whole Society group, the eighty atolls of the Tuamotus, and the Austral and Marquesan islands. Of its considerable exports a small fraction is from Tahiti itself. Hence the fact that the population of this little town equals that of the rest of the island.

Tahiti has a real value to mankind in its history, geological, anthropological and social. Its geological story may yet, by affording the simplest case, give a clue of value to the puzzle of the coral reefs of the world. Its place is conspicuous in the stories of the heroic voyages of the ancestral Polynesians and the evolution of their culture. Finally, in 1815, it became the centre from which civilization spread like a flame, too often a destroying flame, through the Pacific islands; this again, or so it seems to me, is an experiment in sociology from which profit may still be drawn.

DISCUSSION

Before the paper the PRESIDENT (Colonel Sir CHARLES CLOSE) said: I suppose the island of Tahiti, in the minds of most geographers, is linked with Captain Cook and his expedition in 1769. We know the group of Society Islands was given that name because the Royal Society had a great deal to do with fitting out that expedition which was to observe the transit of Venus, and that Captain Cook visited the islands again in 1773. Then the islands had the usual rather sad history of an indigenous population being brought into contact with the evil influences of white civilization, and there is the history, which we shall not hear to-day, of the British missionaries establishing themselves in the island of Tahiti and eventually the islands becoming French. This afternoon we shall have no politics and no history of that kind, for Dr. Crossland, who is a distinguished naturalist, will give us an account of the island chiefly from the point of view of its geology and natural history.

Dr. Crossland then read the paper printed above, and a discussion followed.

Professor STANLEY GARDINER: Surely we must feel very much indebted to Dr. Crossland for bringing us to such a classical island in the Pacific Ocean as Tahiti, the visibility of the transit of Venus from which was the magnet which drew the expedition of Captain Cook and Sir Joseph Banks to those seas. Tahiti is noteworthy for that and other explorations, including those of Darwin, who gave the best account of the island. Recently there was the visit of W. M. Davis, which Dr. Crossland has frequently referred to. It seems to me that Tahiti is an extraordinarily difficult island from which to draw any deductions. The Marquesas, a short distance off, have no reefs. Why should they have no reefs at the present day if Tahiti has reefs? The Marquesas are supposed to be much older; they show much more cutting up; they have much higher cliffs right against the sea; the different valleys are separated from one another by ridges, and there are no flats by the sea which connect them together. Is the history of Tahiti as sketched by Dr. Crossland going to result in a land like the Marquesas? I venture to suggest it is, for if the coast flat is entirely cut away the result will be that the different valleys in

Tahiti will be left, each leading down to the open sea; the population will disappear.

But, sir, is it possible to believe that that coral flat which extends round the coast of Tahiti and underneath the coastal flat right up to the base of the cliffs will be removed? According to Dr. Crossland it will, for he has indicated his belief that not only will the shore flat go but the actual reef as well. The deduction I should make from his paper is that he expects Tahiti ultimately, perhaps in 20,000 years, to have much the same coastal structure as we see round the Marquesas. If so, we have got an admittedly typical coral reef structure absolutely and entirely different from any described reef in any coral region in the whole of the rest of the Pacific, or in the rest of the world, viz. not growing seawards, but being washed away. If Dr. Crossland is correct it is quite possible that we might get a condition which would approach some of the islets in the eastern part of the Atlantic which with seemingly appropriate conditions have no coral reef formations. Dr. Crossland's deductions seem to me equally difficult to accept or to explain away. If we seek some other explanation we are driven to the views of Davis, and the pictures we have seen do not suggest to us the embayed valleys which he would summon to his aid as proof of subsidence. Dr. Crossland tells us specifically that he does not think that they are embayed valleys, but that he is going out again and hopes to determine them with more accuracy. I trust that the next coral reef expedition that goes anywhere will take with it a trained surveyor who will properly survey the valleys such as those of the Great Barrier Reef to find out whether they really give evidence or not of subsidence.

There is one further fact in respect to which Tahiti is quite different from most of the regions in the Pacific. In Tahiti there are no islands in the reefs except islands of coral formation. There is not a single little islet, such as we find off all the reefs of Fiji, or of New Caledonia, or the Great Barrier Reef, of the geological material which belongs to the mainland. They are all simple coral reefs and coral islets, and that makes the area entirely different from any one of the other barrier reefs of the Pacific.

I venture to think, sir, that we know really as yet comparatively little about Tahiti, and we trust that Dr. Crossland when he has been out again will find out more and will be able to solve many of the problems which he has touched upon in his most illuminating address to-day.

Mr. L. J. CHUBB: I have listened with very great interest to Dr. Crossland's paper. During the *St. George* expedition to the Pacific it was my privilege to be associated with him in his work on some of the other central Pacific islands, notably the Marquesas. I may say that he is a very cautious man and will certainly not accept any theory on the strength of the great name of its originator. For that reason his views should be treated with the more respect. I must confess that I had always regarded the valley flats in Tahiti as deltaic infillings of embayments, and therefore as proof of subsidence, but I see now that this view is open to doubt. If, as Professor Stanley Gardiner suggests, the process of marine erosion should continue, the result would be the reduction of Tahiti to a condition very similar to that in which Rapa in the Austral Group is at the present time. This island has many features in common with Tahiti. The crater is well preserved, and so is the plug of plutonic rock occupying the vent, but the outer slopes are very different. Instead of long volcanic slopes on the spurs between the radial valleys, we find razor-backed ridges very much reduced by subaerial erosion. The outer parts of the volcano have been cut back by the sea almost, I think, to the original line

of the crest of the crater rim. This is a condition further advanced even than that found in the Marquesas. The result is that the valleys are completely isolated from each other, and the native tribes were constantly at warfare. Traces of this are preserved in the forts which crown all the higher peaks.

Dr. Crossland was so kind as to say that I had shown that the floor of the Eastern Pacific was occupied by a rigid block that has resisted the pressure brought to bear on it on both sides, with the formation of the folds on which the Society and other islands are situated. As a matter of fact, I have not shown it yet, as my paper is not ready for publication, but I hope to do so shortly. Thanks to the work of Marshall, Iddings, and Lacroix we are fairly familiar with the petrology and the original volcanic structure of Tahiti, but so far we have not had any complete and detailed account of the topography. Until such accounts are available we can hardly draw any conclusions about its more recent history. I think Dr. Crossland has given us just the account we require.

Mr. HINKS: I should like to ask Dr. Crossland a question as to the supposed change in the ocean level due to the withdrawal of water from the ocean to make the polar ice-caps. If I understand him aright the amount of water in the polar ice-caps now, which in his opinion used to be in the ocean, must account for something over 6 feet in the level of the ocean. I presume that in the glacial epoch the amount withdrawn was considerably greater, and I would like to ask whether there is any indication anywhere upon Tahiti of some beach-level—submarine, I suppose it must be—corresponding to the glacial period, and whether one is right in thinking that that top of the surface 6 feet above sea-level now really does correspond to the marine floor before the glacial epoch. I am not sure whether I quite perfectly understood Dr. Crossland.

Dr. CROSSLAND: The little shelves and flats described in my lecture are not, of course, the very great flats at much greater depth described by Professor Daly in his glacial control theory of coral reefs. In the glacial epoch one got depths like 40 fathoms or more at which the glacial ocean eroded the islands upon which Daly supposes the reefs were founded. The little steps that are above the sea, with which I dealt to-night, are an extremely recent phenomenon, probably so recent as 3500 years ago. For instance, the coral flat I described is most extraordinarily fresh, the very freshest elevated coral I have ever seen in my life, quite different from that of the coast of East Africa or the Red Sea. I was astonished at my own conclusions, and could not bring myself to believe what I saw until I had visited the place three or four times. That is an instance of how very recent this last retreat of the sea has been, and it is quite a different thing to the greater retreat of the great glacial epochs of the past.

The PRESIDENT: Well, we have listened to a very interesting account of Tahiti, which most of us probably have not visited. Dr. Crossland has given us plenty of food for thought, and we should like to know more about that 6-foot regression of the sea and also something, as we undoubtedly shortly shall, of Mr. Chubb's theory of the folding of the Pacific floor. In your name I thank Dr. Crossland for his excellent address.

THE KABOMPO GORGE IN NORTHERN RHODESIA

MAJOR C. K. COCHRAN-PATRICK
D.S.O., M.C.

SEEING new country from the air is a most interesting experience. The difference in character between varying localities is far more noticeable than to the traveller on the ground, but the characteristics which make this difference are not as a rule the ones which are seen on the ground. The Earth traveller's movements are to a great extent two-dimensional, and perhaps owing to this very fact hills and valleys, undulating country or plain, are the features that claim first notice. To the traveller by air, however, though his own movements are three-dimensional, ground features are resolved more or less into a plane, and though he may notice a range of hills before coming up to them, unless they are of considerable magnitude or grandeur they will not be a feature which he will remember nearly so well as the general trend of the rivers, the extent or shape of clearings in bush country, or the direction and trend of outcropping rocks.

It is interesting to note that the latter will be equally noticeable, whether taking the form of a high ridge, or flush with the ground surface, or even under the surface, as its effect on the vegetation is even more marked than the appearance of the rock itself.

On the other hand, when your physical feature is one of those rare sights of exceptional grandeur or magnitude, it will stand out from its surroundings with greater interest and magnificence when seen from the air. It is so with the Kabompo Gorge.

It was during the course of a geological air reconnaissance of the Kasempa district, Northern Rhodesia, undertaken by the Aircraft Operating Company for the Rhodesian Congo Border Concession, that we had an opportunity of seeing and photographing the Gorge.

Mr. F. H. Melland described the Gorge as it appeared to him on the ground in his paper on the Kasempa District (*G.J.* 54, 280, Nov. 1919):

> Few places in Northern Rhodesia are more worth visiting; everything is on a grand scale, whereas this country—with all its attractions—has mostly scenery of a monotonous mediocrity. . . . Grandeur is the exception, and for the most part "pretty" describes Northern Rhodesian scenery better than "grand." This Gorge is undoubtedly one of the exceptions, and it is also quite unexpected. The neighbourhood gives no hint of its existence; it does not advertise itself, and so it has remained unknown and unnoticed except by two or three Europeans. I myself had been six years in the district before I heard of it. The hills, cliffs, and rocks are all on a big scale; the timber is good; the candelabra euphorbia large and prominent. The river itself, big enough in its lower reaches, is here of small volume; but even it—save where it hides itself underground—makes the most of itself and looks big enough for its surroundings.

From the air it is entirely different. Our first sight of the Gorge was

The Kabompo Gorge looking south from 3000 *feet*

The Kabompo Gorge looking north from 3000 *feet*

unexpected. We were feeling our way on a compass bearing out towards the Angola border. The clouds were down at 5000 feet, and we were just below them. Only the ground directly underneath was at all clearly visible, as the cloud shadows at any distance got hopelessly mixed up with dark patches of forest or burnt clearings and, especially to the north into the sun, ground features rapidly merged into a dark haze. We had just come up to a point where three fair-sized streams joined to form a river, which we made out to be the Kabompo, when there loomed through the haze to the north the great rounded mass of a gigantic tree-covered mound. Then, as we flew farther west, a cleft right through the centre of this mound, from its highest point to its base, suddenly showed; and then the whole mass faded into the haze again.

The sight was so intriguing that we at once decided to spend some time on its examination and to try to get some photographs. Fortunately the weather was kind, and the occasion of our next visit was a clear sunny morning with excellent visibility. The country to the north and east of the Gorge is undulating, with occasional hills and short ridges, but, from any height over 5000 feet, it all appears flat plain. Out of this rises the mound containing the Gorge, steep to the north and south, elongated and gently sloping to the east and west. On a clear day it can be seen from the air for many miles; in fact, it dominates the surrounding country and was used by us as a landmark in all our subsequent flights to that neighbourhood.

One's predominant impression is one of amazement that any river should take the apparently unnatural course of making straight for the highest ground for miles around, and cutting a cleft right through the middle of it. From above it looks as if a divergence of a few miles either east or west would have led the stream round the obstruction on a gentle uneventful path. Actually a study of the oblique photographs in the stereoscope reveals the fact that the bounding watersheds to either side are higher than they appear, being dwarfed by the culminating mass to the south.

To attempt to describe the Gorge in detail would be superfluous; the photographs can do that far better than I can. Moreover, one's impressions from the air are general, not detailed, and usually breed an intense desire to fill them in by a visit to the spot on the ground.

AIR SURVEY

MAPPING FROM AIR PHOTOGRAPHS. [By Lieut.-Col. M. N. MACLEOD, D.S.O., R.E.] Issued under the authority of the General Staff, War Office. *London: H.M. Stationery Office* 1920. 13×8 *inches;* 66 *pages, and plates.* 4*s*

REPORT OF THE AIR SURVEY COMMITTEE, No. 1 1923. The War Office. *London: H.M. Stationery Office* 1923. 9×6 *inches;* 132 *pages; diagrams and illustrations.* 4*s* 6*d*

GRAPHICAL METHODS OF PLOTTING FROM AIR PHOTOGRAPHS. By Lieut.-Col. L. N. F. I. KING, O.B.E., R.E. [Since numbered as Professional Papers of the Air Survey Committee No. 1.] The War Office. *London: H.M. Stationery Office* 1925. 9×6 *inches;* 92 *pages, and diagrams.* 3*s*

SIMPLE METHODS OF SURVEYING FROM AIR PHOTOGRAPHS. By Lieutenant M. HOTINE, R.E. (Prof. Papers A.S.C. No. 3.) The War Office. *London: H.M. Stationery Office* 1927. 9×6 *inches.* 3*s* 6*d*

THE STEREOSCOPIC EXAMINATION OF AIR PHOTOGRAPHS. By Lieutenant M. HOTINE, R.E. (Prof. Papers A.S.C. No. 4.) The War Office. *London: H.M. Stationery Office* 1927. 9×6 *inches;* 84 *pages; plates and diagrams.* 3*s* 6*d*

FIVE minutes after the first successful photograph was taken from an aeroplane it became an axiom that here was a wonderful new method of mapping, that must be capable of doing at ease from on high everything—except discovering names—that the topographical surveyor was accustomed to do by painful progress about the ground. During the War we became accustomed to maps of the enemy organization on a large scale and full of accurate detail, made by methods in which the aeroplane played a spectacular part and the ground surveyor was so inconspicuous that he was sometimes overlooked. In nine years of peace and progress we have heard in the newspapers much talk, not entirely disinterested, of the marvellous efficiency and economy in time and money of air surveys conducted for commercial ends; but until the last few months very little of their use as an arm of the official survey department. Wonderful machines have been devised, especially upon the Continent of Europe, for plotting and contouring stereographically from pairs of air photographs, and many experimental surveys of small areas have been made and discussed; yet it has seemed that in some way the promise has not been fulfilled; the maps that were to have been made so easily by sailing over the country have not materialized in any number; and, if propagandist statements are given a prudent discount, it is a little hard to say crisply what is the present condition of air survey, and what are its uses and prospects.

To begin with one must distinguish more accurately than is the general habit between survey and reconnaissance. It is relatively easy to cover a belt of country with a series of overlapping photographs that are quite invaluable to an engineer prospecting for a railway route or a power line in unmapped territory: but this is reconnaissance, and must not be called survey until from the photographs one can produce a map that comes up to a chosen standard of accuracy, so that a similar map of an adjacent area will fit on to it within recognized limits of error. The method has painful limitations if it will work only when the ground is dead flat, or when the air is so clear that the horizon can always be photographed as an essential feature in the picture, or if it requires three days' calculation before a plate can be plotted. We should not at first look too closely at expense, for no process can be worked economically

until it is standardized, and a method is worth developing if it can on occasion obtain results—however expensive—that no other method will give. But it is necessary to insist that before it may be called survey a method shall be capable of producing sheets of detail that can be fitted in an orderly way into some system of control, tied down to earth as a plane-table sheet is tied into the triangulation. And it must be capable of dealing with country that is not flat.

The end of the War found the contending armies each with a large organization for interpolating new and changing detail into the large-scale maps of the trench systems, from photographs taken as gunfire and enemy machines permitted. Regular programmes and steady level flying were the last things possible on the western front; but the problem of fitting isolated photographs into abundant ground control was relatively simple. In the East there was less interference from the enemy; but also much less ground control. It was soon realized that this situation demanded long series of overlapping photographs; but neither the training of the pilots nor the instrumental equipment of the machines had reached the standard essential to real success. The end of the War broke up the organizations on all fronts, except that of the field-survey battalion with the Army of the Rhine, whose commanding officer, Lieut.-Col. M. N. MacLeod, occupied himself at Cologne with putting into shape the result of his experiences in the field and his reflections thereon. The resulting thin folio volume—*Mapping from Air Photographs*, published in 1920, forms the base of much that has followed.

In the same year, 1920, the Air Survey Committee was formed, to co-ordinate the efforts of the G.S.G.S., the Ordnance Survey, and the Air Ministry, all interested in different aspects of the problem. It was their task to initiate a programme of instrument construction at home, and to keep abreast of the flood of invention and propaganda on the Continent of Europe, whose opticians and engineers had embarked on a policy of construction admirably bold, difficult to assess, but at least impressive. British instrument makers showed no inclination whatever to sink capital in construction on the grand scale which they deemed—perhaps rightly—could never be a commercial success. The task of invention and research lay for some years almost entirely in the hands of the Air Survey Committee.

Their first report, published in 1923, began with an excellent summary of instruments, methods, and results up to the year 1920, when the Committee took the problem in hand. It then set out the progress which the Committee had made, reviewed what had been done elsewhere, and made of the very scattered literature an exhaustive bibliography, which has been continued in supplements. There are fascinating instrumental difficulties in taking a series of photographs regularly overlapped and squared on each to the next, for the flying speed is subject to sudden accelerations, and drift of the machine sets the plates in echelon, while small changes in the rigging will easily tilt the camera through several degrees, even if the pilot does not unconsciously put the nose of the machine down to regain lost speed, or bank to regain lost direction. The report lays great stress on the training of pilots, but realizes that tilted photographs will occur and must be dealt with systematically.

When four ground points are known and visible on the plate, the height and the tilt can be calculated at the cost of many hours' work. If the focal length and the optical centre or principal point of the plate are known, the four points may be reduced to three; and it is curious how long it took to get cameras properly calibrated, to take advantage of this simplification. But whether the tilt is to be eliminated by photographic "rectification," or by transferring the map grid to the photograph in perspective, or whether the plates are to be

plotted stereographically, it is first necessary to find the tilt and the height at the moment of exposure, and great efforts have been expended in devising and making a "tilt-finder" that shall perform this necessary office economically. The geometrical principles were clearly set out by Colonel MacLeod in 1920, and two machines have been built; but we are not yet assured that they have been completely successful.

The Committee in 1923 were a little sceptical about the merits of stereographic plotting, after studying the Autocartograph of Hugershoff; and if we may judge from the fact that the firm of Heyde at Dresden have recently brought out a new and simpler and less expensive model, their scepticism seems to have been justified. But they are perhaps hardly fair to the method itself when on page 59 they ask the question: "Why use the stereoscope when it is unnecessary? The air is free; the aeroplane can take up any position. It seems therefore that to fix positions by a method which demands more or less acute intersections is to limit the power of aerial survey." The reply, which they partly give themselves, but unconvincingly, is of course that the stereoscope saves all the difficulty of identifying corresponding points on the two photographs, which is formidable with a short base and quite destructive with a long one. And if rumour is true the Air Survey Committee have provided a more convincing answer by constructing themselves a stereoplotting machine, for news of which we are all agog.

But these things take time, and the infantile complaints of a new construction are always tedious. Meanwhile we have to notice Colonel King's useful book on Graphical Methods of Plotting. The geometry of the image on an oblique photograph is troublesome rather than difficult, but the treatment it has received in various books has made it a regular jungle of a subject. The classic work of Deville presented a stately array of little propositions that never quite seemed to converge upon the point; and the literature is full of theorems in perspective geometry that seem to have been dragged in because they might at some time be useful, rather than with any clear indication of what use they really were. We believe, after promising attempts, that the whole theory might be written out in a few pages if one started with Colonel King's figure on page 78 a little generalized; it gives by far the most instructive view of the problem that we have seen, and many of his propositions scattered through the book come out without the least trouble, with the great advantage that they all fall into place.

Of the great variety of methods that might be practised with more or less success according to the local circumstances, there seem to be few that are now reckoned of much importance, and only one that is in regular use by a survey department—the Canadian method. The Canadians have employed air survey extensively in the flat forested lake country that is known as Laurentian. Here they use photographs so oblique that the horizon is shown on the top of the plate, for the air is so clear that the horizon can be photographed on the average two days a week. When the horizon is there, only two control points are necessary for constructing a perspective grid, by the interesting method that Colonel King explains. But to have even two control points per field requires a traverse on the ground to determine them, and it is precisely traverse on the ground that is so difficult in this country of no communications. Hence has arisen an interesting and rapid approximate method. All the photographs are taken with camera of standard pattern, and as near as possible at a standard height and standard obliquity. A whole series of standard perspective grids is drawn, for intervals of 25 feet in height, and for distances of the true horizon from the margin of the plate differing by tenths of an inch.

On a plate which shows the visible horizon the true horizon can be deduced by applying the refraction and dip, and a grid corresponding to this horizon and to the approximate altitude is selected from the set. With this grid the photographed positions of two control points are rectified and compared with their plots on the map grid, which gives at once a correction to the assumed height and indicates the grid with which the whole photograph should be plotted. When a start is thus made from a pair of controls successive plates of a photographic traverse may be tied on, and the whole closed upon another pair of controls. All this is fairly accurate and very effective in suitable country that is, flat, with a good horizon, and very clearly marked detail, *i.e.* lakes. It is not for general application, because unless the distant detail in the oblique pictures is unusually clear, the method fails.

We must however seek a general method that is not powerless in the hills. It seems to be now accepted by the Air Survey Committee that contouring from the air can be done effectively and economically only by a stereoscopic method—the alternative makeshifts may serve for an odd plate or two, but are not good enough for regular work. Pending the completion of more elaborate apparatus they have made a very interesting experiment in the survey of about 20 square miles of country near Arundel, recently described in No. 3 of their Professional Papers by Lieutenant Hotine, R.E., their Research Officer. A machine of the R.A.F. equipped with a Service F.8 or Eagle Camera, working on films 7 inches square, and with a focal length of 10 inches, took the photographs in strips with an overlap of 50 per cent., and as nearly vertical as possible. We can make no attempt to summarize the rather intricate method by which a contoured map was made from this material. It involved a preliminary selection and rough plot of a close auxiliary control; a survey of this control with theodolite, and a considerable number of heights determined with a battery of aneroids; and finally contour-sketching with the Topographical Stereoscope of Barr and Stroud. We understand that the intention was to plot at 4 inches for reproduction at 3 inches to the mile; but the specimen is enlarged and printed on the back of a 6-inch sheet of the O.S., which is an over-severe test. One may say that the horizontal detail comes out very well, and the contours are there or thereabouts. Open grassy downs with no detail make a stiff subject to begin upon, and it would be unfair to criticize this first attempt minutely. But it is probably fair to say that the enthusiast for air survey will be disturbed to see how much ground work was wanted, and how little could be done without it. We may thus be led to suppose that the future lies with the elaborate stereoplotter, and that stereosurvey from ground stations will provide the framework of conspicuous detail on which the air photographs will be hung. From a good set of air photographs either vertical or oblique all that ground in the Shaksgam valley which was dead to Major Mason's stations could be tied on precisely to the peaks and ridges that he fixed with the Phototheodolite.

While the subject is still very much in the experimental stage one may see that it is steadily advancing, by comparing the ideas of the Arundel survey with those set out in the Report of 1923. A second report on similar lines, bringing the survey of methods both British and Foreign up to date, would be a most useful document, which we hope to see soon. Without some such guide the student of air-survey methods is lost in a wilderness of tendencious statements; with it a young geometer might do excellent service in reducing the rather chaotic mathematics to order and clarity; and would be doing no harm if he looked with suspicion on the very doubtful theories of stereoscopic vision that are about.

A. R. H.

THE WAHHABI KING

IBN SA'OUD OF ARABIA: His People and his Land. By AMEEN RIHANI. *London: Constable & Co. Ltd.* 1928. 9×6 *inches;* xviii+370 *pages; sketch-map and illustrations.* 21*s*

IN this volume the author, who is an American citizen by nationality, a Christian Syrian by birth, and primarily, I believe, a *littérateur* by profession, gives us a vivid account of his journey from Bahrein to the Wahhabi capital at the end of 1922; his sojourn there for six weeks as the guest of Sultan 'Abdul 'Aziz and his subsequent return to the coast of the Persian Gulf at Kuwait.

Having regard to Mr. Rihani's pretty command of their language English readers will be disappointed to find, before they have dipped very far into his book, with what a lively spirit of ill-feeling he seems to be imbued towards British policy and British officials in the Middle East. This spirit has apparently lost nothing of its tang from having been five odd years in bottle, and surely blends ill with that other "spirit of love that excludes no one in this little world of ours," with which, when a lone Christian in the heart of Arabia, he one day professed to be animated (p. 141). It is inevitable, we know, that the Consular official in conscientious discharge of his duty should sometimes appear as the natural enemy of the impetuous pilgrim, but in the present case, to account for the delays of which Mr. Rihani makes such a grievance, it seems unnecessary to look farther afield than the primitive methods prevailing at the time for communication with the interior of Arabia. And this on the author's own showing, for we find that the first letter received by the self-invited visitor from Sultan 'Abdul 'Aziz was only written from Hasa on November 17 (p. 22), and would have taken another couple of days to reach its destination; and though the traveller's itinerary is not overloaded with dates, it is clear that he must have been piloted over to the mainland almost immediately after the receipt of the Sultan's written permission.

It will be noted, moreover, that Mr. Rihani has thought it well to emphasize (p. 21) that "the people of Nejd do not want any foreigners in their land; one foot," they say, "brings a thousand"; and having regard to this not unnatural sentiment, it is the more important to bear in mind that in that after-war period the backward regions of the world were overrun by all sorts of adventurers —traffickers in surplus arms, of which of course there was a glut; concession-hunters, many of them smeared with oil; fishers in troubled waters, *et hoc genus omne;* and so it became doubly incumbent on British officials concerned to assure themselves of the consent of native rulers before allowing stray travellers to be dumped from British vessels upon their territories.

Mr. Rihani's objectives, be it well understood, were of no such categories as those. He embarked on his pilgrimage in quest of material for a book and in the hope of promoting his ideal of Arab unity. Yet, innocent as such motives might be regarded in principle, it will be apparent, from a scrutiny of the "expanded" scheme, which, as he tells us at p. 67, he was prompted to propound to his friend the Sultan, and which disposed, *inter alia*, of a Sovereign State in treaty-relations with Great Powers, that the naïve ideas of the wandering scholar from the Lebanon ill qualified him to reconstruct the political geography of the Arabian peninsula. Much less were they calculated to promote the cause of peace within its borders. A like conviction is engendered by the author's remarks at p. 223, where, having enunciated a plainly erroneous hypothesis, he employs it to claim for Sultan 'Abdul 'Aziz the right to occupy the principalities of Kuwait and Qatar, and even the kingdom of 'Oman—

ground, forsooth, whereon angels might well fear to tread! Our author is much more in his element when he leaves the sphere of politics and embarks upon the racy narrative of his treks to and from the coast, and his six-weeks' sojourn at the Sultan's capital. There at least we can profitably follow him.

He journeyed to Hasa on camel-back by the ordinary route from 'Oqair, the Sultan proceeding ahead of him, but having developed a severe saddle-sore on the way, he found himself mainly occupied during the few days of his halt at Hofuf in nursing his epidermis for the vicissitudes of the onward journey. He consequently saw little of the neighbourhood; but it was here that he began to enjoy that close acquaintance with the daily life and habits of his royal host, on which he writes so interestingly. The Sultan's 'Half-hours with the Best Authors' for the benefit of his followers in the early morning, which we now hear of for the first time, seems a most attractive form of public education!

His Highness did not tarry long in Hasa, and having disposed of such business as had accumulated, was soon ready for the onward journey to his capital. He again proceeded somewhat in advance of his guest, in order, no doubt, that the latter might come along quietly at his own pace. Here again the route taken was naturally the ordinary one, traversed and described comparatively recently by Leachman and Philby; but Mr. Rihani's lively narrative is none the less welcome. Incidentally he tells us how one day, at the end of a terribly hot and thirsty trek over a tract of lava-drift, when he and his companions were about to sit down to meat, he shocked them all by consuming his portion of lamb's meat raw, cutting it into small pieces which he ate with his unleavened bread. It appears that this is an ordinary custom in Syria, but in Central Arabia he found it unknown.

On the whole the terrain between Hofuf and Riyadh appeared to him very barren and unattractive, so that he was greatly relieved to reach the end of the journey, and writes: "Of all the scenes in my Arab travels that gave pleasure to the eye or to the soul, none was more pleasing or more welcome than this, the capital of Nejd among the palms. For I had really suffered much and endured much to reach it."

The account which follows, of his six-weeks' stay at Riyadh and his subsequent passage to Kuwait *via* Washm and Qasim, forms the most valuable part of his narrative and makes very good reading. He seems to have been greatly impressed—I might say oppressed—by the appalling austerity of life and manners prevailing in the Wahhabi city; by the sullen bigotry of the religious hierarchy and their all-pervading authority; and by the saturnine and pharisaical attitude of the Riyadhis in general; not indeed directed against Christians in particular, but against all non-Wahhabis indiscriminately. In such a setting he gives us a strange, almost a pathetic picture of the lonely Sultan towering intellectually over his benighted subjects, "like a palm-tree in a field of stubble," and so finds little cause for wonder at the ruler's frequent absences from his capital. Then we are given a useful historical sketch of the Wahhabi movement from its commencement, and an exposition of Sultan 'Abdul 'Aziz's masterly policy in the development of it for the better accomplishment of his own patriotic ambitions. Incidentally the writer pays a great tribute to the extraordinary success of his strong administrative *régime* in establishing complete internal security within his territories.

As a Syrian with a perfect command of Arabic, Mr. Rihani was of course equipped as no European traveller could be for gaining intimate touch with the life of the Ruler and his subjects. He has made good use of his oppor-

tunities and given us a resulting picture which is particularly valuable at the present time. Whether Sultan 'Abdul 'Aziz, since recognized by H.M.'s Government as King of the Hejaz and of Nejd, will altogether appreciate the partial lifting of the veil from the recesses of his private life is perhaps doubtful, but it is to be hoped that the author has satisfied himself on that point.

It is not specifically apparent from the text how the traveller's sojourn at Riyadh was brought to a close, but he was unfortunate in being shadowed throughout his stay by the spectre of malarial fever, and that no doubt prompted him not to tarry too long.

The route he took to the coast, if not the most direct, was the well-defined one *via* Shaqra, 'Anaiza, and Buraida, and thence by the direct road to Riqa'i, Jahra, and Kuwait. The Shaqra–Buraida section was geographically the most important part of his journey; Washm (Shaqra) in particular being a district which, except for Sadlier's passage through it a century ago, was practically unknown to Europeans until Leachman passed through it in the opposite direction, when on his way from Leina to Riyadh in 1912–13 (*G.J.* 43, p. 514). Shaqra, the capital of the province, the population of which Mr. Rihani estimates at about the same figure as Captain Leachman did (5000 souls), is an oasis of no little importance, and both travellers agree as to the abundance of water prevailing and the general fertility of the district.

Mr. Rihani, it must be remembered, was not equipped for geographical exploration, and presumably employed no more precise methods of estimating distances and judging directions than the rate of camel-travel and the course of the sun; but he appears to be right as to the unreliability of our latest maps as regards this region. Thus, whereas Mr. Rihani states that it is not more than 30 miles from Mudhnib to 'Uyun es Sirr, and 12 miles from Mudhnib to 'Aushaziya, Leachman's map makes the former distance about 50, while Hunter's map makes it nearer 60; and the latter makes the distance to 'Aushaziya as much as 20. Moreover, if 'Aushaziya is correctly placed due east of 'Anaiza, it is not apparent why a party travelling north from Mudhnib to 'Anaiza should pass through it *en route*.

In conclusion, I refrain from discussion of the author's system, or want of system, in transliteration, as he does not claim to be in any way consistent, and disarms criticism in his prefatory note on the subject. On the other hand, I cannot pass without comment his fanciful rendering of the Arabic word "Khatoun," as applied to Miss Bell in 'Iraq. Mr. Rihani is tempted to render it "A lady of the Court who keeps an open eye and ear for the benefit of the State." This rendering may suit his mood but, in fact, it is the ordinary word used in 'Iraq, for "young lady," or "mademoiselle," and Miss Bell was known to all and sundry in 'Iraq as "The Khatoun," *i.e.* "The Mademoiselle," from her first arrival in 'Iraq, long before there was any Court or State for her to benefit.

P. Z. C.

RAYMOND'S MAP OF THE ALPS

THE Map Room of the R.G.S. has received an important and welcome addition in the form of a complete copy of a map, presented by Mr. H. H. Clough, the full title of which is as follows:—

Carte topographique militaire des Alpes comprenant le Piémont, le Savoie, le Compté de Nice, le Vallais, le Duché de Gênes, le Milanais et parties des pays limitrophes, dressé à l'échelle d'un mètre pour 200,000 mètres. Par J. B. S. Raymond Capitaine . . . Paris. 1820. [*At foot:*] A Paris chez l'auteur, Cloitre St. Benoit, Passage du Sorbonne No. 28, et chez les principaux Marchands de cartes.

The twelve sheets of this attractive map comprise the country between Geneva and the Stelvio on the N.W. and N.E., Cannes and Le Spezzia on the S.W. and S.E. Spread on the wall it gives a bold and picturesque presentation of the Western Alps and Appenines as a whole. Its purpose, as stated in the title, was military, and it is drawn from the point of view of a French invader of Italy. It shows effectively the main features and passages of the Alps leading from the basin of the Rhône into Piedmont and the Milanese. It stops short at the St. Gotthard. In general appearance the style in which it has been produced somewhat resembles the Dufour map. Relief is shown by vertical hachures, and the engraving of most of the sheets has been well done.

There is room for much criticism in detail from the physical point of view. The cartographer seems in certain districts to have been misled by his material —or lack of it. Flagrant examples of inaccuracy will be found in the Upper Engadine and Livigno districts; in the relations of the valleys behind Locarno at the head of Lago Maggiore, and in those on the north side of the Pennine Alps. The avowed object being military, it seems particularly regrettable that he should have depicted in the same way passes practicable for wheels and bridlepaths; or should in many cases have indicated fantastic tracks, "high-level routes," where none exist, or are even possible: *e.g.* across the glaciers direct from Evolena to Breil. As a rule he ignores glaciers except in the Bernese Oberland, though he faintly suggests a few little ones under Mont Blanc.

For casual treatment of peak nomenclature a military mapmaker can, perhaps, hardly be blamed. But mountaineers will note with some historical interest that the peaks and glaciers of the Bernese Oberland are for the most part rightly placed and named (the Bietschhorn being the only conspicuous omission), while on the other hand the great Zermatt peaks have got badly mixed. We find "Mont Rose," the Breithorn, and the Petit Cervin fairly correctly located: but the Matterhorn has changed places with the Weisshorn, which in turn usurps the post of the Dent Blanche, while Mont Cervin appears on a spur somewhat north of the true situation of the Matterhorn. In the Mont Blanc range the only secondary summits indicated are the Aiguille d'Argentière (put, as usually at that date, in the place of the A. Verte) and "le Géant."

In the French Alps the mapmaker deals scantily with peaks but calls almost every gap a col and finds a name for it. About the hypothetic Mont Iseran he hedges thus, "Mont Iseran Col."

Capt. Raymond (who as one of the corps of "Ingénieurs géographes militaires" had seen much service as a surveyor during the wars of Napoleon and the subsequent frontier delimitations) was also responsible for the "Carte militaire topographique et stratégique de la Lombardie et de la Vénétie" which

appeared later as a supplement to his map, as well as several other smaller maps, three of which are in the Society's collection. One is of the chain of Mont Blanc, and is stated to be intended for the use of readers of de Saussure's travels and of tourists. Another shows the neighbourhood of the Mont Cenis, and writers on Hannibal's Pass may note that it neither names nor indicates the track of the Col du Clapier. The third is a map of the department of Mont Blanc reunited to France by the decree of the National Convention of 29 Nov. 1792. D. W. F.

REVIEWS

THE ITALIAN RIVIERA, its scenery, customs and food, with notes upon the Maritime Alps. By BOHUN LYNCH. *London: G. Harrap Ltd.* 1927. 7×4 *inches;* 254 *pages; illustrations and map.* 7*s* 6*d*

SICILY PAST AND PRESENT. By ASHLEY BROWN. *London: Methuen Ltd.* 1928. 7×4 *inches;* xii+188 *pages; illustrations and map.* 6*s*

ITALIAN TRAVEL SKETCHES. By HEINRICH HEINE, translated into English by ELIZABETH SHARP. *London: Foulis* 1927. 8×5 *inches;* xviii +250 *pages; illustrations.* 6*s*

Mr. Lynch knows the Italian Riviera well, and gives us here a readable account of a walking tour from the Mont Cenis through the Alps to Ventimiglia and then along the Riviera to Spezia. We are inclined to think that food ought to have come first in his sub-title, for it is this even more than the walking or the scenery or what he has to tell of the customs that remains in the mind—the inns and above all the meals and the wine. He is profoundly interested in every aspect of this important question, even down to the preparation of the ingredients, as in his account of the making of *tagliatelli*. His insistance that tomato sauce is not a traditional addition to *spaghetti* shows that it is North Italy which he knows best. In Naples and the south, the real home of macaroni, it is almost universal; nor will you find *ravioli* there—a sad want, we admit. The information he gives for those who wish to follow in his footsteps is varied, practical, and detailed, and will be useful not only to those who wish to see this beautiful coast from a different angle than that of a tourist hotel—to see Italians, in fact, and not fellow-tourists—but also to the more conventional English traveller. The gazetteer at the end contains enough information about the chief places of interest to enable us to do sufficient sight-seeing of a more formal kind, if we are so inclined. This is a book for the tourist who enjoys the tour for its own sake rather than for the historically or artistically minded.

Mr. Brown's book on Sicily is of a different stamp. It is not in modern Sicily or in the Sicilians that he would interest us. His is a guide-book pure and simple. He takes the principal towns in the island and describes the chief objects of interest carefully and systematically. His interest is clearly in ancient, and above all in Greek, Sicily, as we find when we turn to his historical chapters, though he has, of course, something to say of the Arabs and Normans. The rule of the Spaniards and the more recent story of the island are passed over in silence, and he clearly has made no attempt to get into real touch with the Sicilians of to-day, or at least, if he has, we should not guess it from his book. He describes the Messina earthquake in some detail. However, he is sound and business-like, and the tourist bent on seeing the monuments will find him a useful companion.

Heine's 'Italian Travel Sketches' seems hardly a book to figure in a geo-

graphical journal; it is not for what he has to tell us of Italy that we turn to them, with their inimitable charm, but for the light they shed on their author. The places he visits are little more than pegs on which to hang his thought, though doubtless they fired the train. The chapter on Lucca, for instance, is almost entirely taken up with discussions on religion and the Church. But when Heine does linger for a moment on a town, or a figure, or a picture, there can be no question of the quality and the vividness of the result. The translation is good. L. C.-M.

ZUR MORPHOLOGIE DER HOCHFLÄCHEN DES LINKSRHEINISCHEN SCHIEFERGEBIRGES und angrenzender Gebiete. Von Dr. R. STICKEL. *Veröffentln. des Geogr. Instituts der Universität Bonn* 1927. 9×6 *inches;* 104 *pages and a map*

This monograph deals with the peneplains and allied structures of the Block Mountain country between Saarbrücken and Kaiserslautern in the south, and Düren and Cologne in the north. The Rhine may be taken as the eastern boundary, and a line from Saarbrücken passing through Trier to Düren marks roughly the western boundary.

The treatment is, for the most part, regional. The various "plain-like" surfaces are described in some little detail. The early chapters, however, are of more general interest, especially chapter 2: "Allgemeines zur Flächenmorphologie." The writings of Penck (W.) and others are considered in so far as they are concerned with matters allied to the present subject. The author discusses the nature and origin of the several types of plain exemplified in this area.

The general scheme is summarized in the preface: "Die Arbeit, wie sie nun vorliegt, möge bewertet werden als ein erster Versuch, dem Problem der Abtragungsflächen auf einem bisher wenig begangenen Wege nachzugehen, letzere nämlich so weit als möglich zu verfolgen und ihre wechselseitigen Beziehungen möglichst vollständig zu klären."

The monograph is a useful commentary on one aspect of Physiography, and gives a good account of this particular aspect of the morphology of the area it describes. J. A. S.

JOURNAL OF FRANCIS BUCHANAN kept during the Survey of the District of Shahabad in 1812–13. Edited, with notes and introduction, by C. E. A. W. OLDHAM, C.S.I. *Patna: Superintendent of Government Printing* 1926. 10×6 *inches;* xxi+192 *pages; two maps and a plan.* 2 *rupees* 9 *annas*

In 1807 the Directors of the East India Company decided to institute a comprehensive survey (statistical, economic, archæological, etc.) of the Bengal Presidency, and selected for this duty Dr. Francis Buchanan (afterwards Buchanan-Hamilton), who had already proved his fitness for the work by making similar investigations in Southern India. For seven years Buchanan laboured diligently at his task, and then in 1814 he was appointed Superintendent of the Botanic Gardens at Calcutta, on the removal of Dr. Roxburgh. A breakdown in health drove him to England in the following year, and in 1816 he retired from the service. Surprise has been expressed that the Directors took no steps to publish the results of his investigations; but it must be remembered that these were incomplete (since he had only dealt with certain districts), that they were very voluminous, and that the Company, which had in 1813 lost its exclusive trading rights as regards India, was busily engaged in retrenching its expenditure. Buchanan's reports, etc., were there-

fore left in manuscript in the Company's library, where they served as a quarry for later workers. Robert Montgomery Martin pillaged them for his 'Eastern India' (1838); and some use was made of the collection by Sir William Hunter when preparing his 'Imperial Gazetteer of India.' One portion—that relating to the district of Dinajpur—was published in full at Calcutta as far back as 1833.

Expert investigation has fully proved the value of Buchanan's researches; and recently the Bihar and Orissa Research Society, aided by the local government, made a start with the publication of his manuscripts, commencing with his journals of his tours in various districts. The first instalment, dealing with Patna and Gaya, was published in 1925, under the editorship of the late Mr. V. H. Jackson, who had been for several years a warm advocate of the scheme. The volume now under review is the second of the series, and chronicles Buchanan's survey of the Shahabad district during the cold weather of 1812–13. It has been admirably edited by Mr. Oldham, who has contributed a full introduction, notes, and some useful appendices; while two maps and a plan add to the attractiveness of the volume. It is unnecessary to praise Buchanan's text. To the general reader the most interesting portions will probably be those describing the fortresses of Rohtasgarh and Shergarh, the mausoleum of Sher Shah at Sasaram, and the Guptesvar caves. W. F.

BIG GAME SHOOTING IN THE INDIAN EMPIRE. By Lieut.-Col. C. H. STOCKLEY. *London: Constable & Co.* 1928. 9×6 *inches;* x+200 *pages, and illustrations.* 18*s*

This book is an encyclopædia for those who wish to shoot big game in India. It is divided into two parts. The first part consists of detailed instructions about everything that the sportsman is likely to require. He will learn from it exactly how he should equip himself, the kind of material and supplies he will need, how much his expeditions will cost. It will teach him how to choose the best shooting areas, how to make the most comfortable and efficient camps, how to find, to stalk, to track his game, how to shoot it when it is marked down, how to skin it when it is killed, how to preserve the valuable trophy. Then the different plans of shooting are discussed: the method of securing the beast by tracking, the method of driving it out by beating, the method of sitting up at night. All this information is clear and practical. Not a detail of importance has been forgotten. The sportsman will find it a compendium of facts.

The second part consists of a description of the animals. It does not claim to be a zoological treatise, but contains those essential points of information which the sportsman is likely to need. In addition the book has numerous illustrations, many of them photographs of game animals either wounded or recently killed.

We must confess to being somewhat out of sympathy with books that deal with the slaughter of wild game. Colonel Stockley is a sportsman of immense experience. His practical book—we say it with regret—will pass on his great efficiency to others, and still further increase the thousands of animals slaughtered annually in the name of sport. R. W. G. H.

THE INFLUENCE OF THE GEOGRAPHY OF INDIA ON ITS HISTORY. By SHAMSUL GHANI KHAN. *Privately printed, N.P.* [1927]. 7×4 *inches;* iii+34 *pages*

The author of this brochure, who is the Head Master of the Government Training School at Ajmer, has put together for the use of students and teachers

some of the salient instances of the influence of geography on history in India. He shows why India has always tempted invaders, and gives reasons for the comparative immunity of the south. He indicates the inevitable routes of successful invasion, the places where decisive battles must be fought, the advantages of a site at or near Delhi for an imperial capital, and the reasons for the failure of arbitrary attempts to establish capitals at Fatehpur, Sikri, and at Deogiri in the Deccan. He also shows how geography favoured the Marathas in their earlier conflicts with the Moguls, and helped the Rajputs in their resistance to Muhammadan domination. The author is not afraid of making strong statements, *e.g.* that the wealth of India was "ultimately responsible for the recent Great War," that, had it not been for the Directors of the East India Company, who preferred trade to territory, Northern India up to the Indus "would have been in the hands of the English within ten years of the battle of Buxar" in 1764, and that his fellow-countrymen are, as the result of climate, "void of the instinct of enterprise." W. H. A. W.

MAGIC LADAKH. By Major M. L. GOMPERTZ. *London: Seeley, Service & Co. Ltd.* 1928. 9×5 *inches; 292 pages; illustrations and sketch-map.* 21*s*

This travel book covers no new ground, nor does it add in any way to our geographical knowledge. Such a book is often pleasant reading owing to the personal element, but 'Magic Ladakh' cannot even be said to have that to its credit. It is only now and then that the author allows us to share his pleasures, which, judging from his opening chapter, are many. It is only fair to say that he has evidently studied the existing literature on this part of the world, and that his facts have been correctly summarized. We have chapters dealing exclusively with the history of Ladakh, its priests, its monasteries, its inhabitants, but these after a time become heavy reading. There is, however, one interesting chapter on the Nubra valley in which the author discusses its features and makes certain comparisons with which in some respects the reviewer cannot agree. Travellers who have crossed the suspension bridge built by the Indian Government over the Shyok river will read with interest that a flood at the time the author was there completely washed away this bridge. It may be noted that it is nearly a century since the last of these inundations occurred, several having taken place in the Nubra valley in the early part of the last century.

Travel books without a map showing the author's route have been the subject of severe comment by reviewers. Yet the publishers have allowed this book to appear without one. Any reader who has little or no knowledge of this region will find it difficult to locate himself on the map supplied. The photographs are numerous and show typical scenes in Ladakh.

At the time of writing the Permanent Committee on Geographical Names has not dealt with this part of the world, and possibly the author may have thought this an excuse for using his own form of spelling. The Survey of India recently published 'Routes in the Western Himalayas, Kashmir, etc.,' vol. 1, and if any attention is to be paid to spelling this should be the authority to follow. It is unfortunate that the book has taken its present form, as the author's previous attempt gave one every reason to expect something better from him than what amounts to a mere compilation of facts on Ladakh.

B. K. F.

MY NIGHTMARE JOURNEY. By DOROTHY FOX. *London: P. B. Beddow* 1927. 8×5 *inches;* xii+128 *pages, and illustrations.* 7*s* 6*d*

The title of this book raises more alluring expectations than its contents justify. It is a rambling account, written in homely style, and padded out with much trivial detail, of a journey from Yunnanfu to Haiphong by rail, thence by steamer and boat up the Yangtze Kiang to Chungking, and finally by road to Chengtu, in Szechwan—the land of the Four Streams. The book adds nothing to our information, though it might have served well enough for letters to a boy at school.

Those who care to read it however will receive fresh impressions of the immeasurable poverty and dirt of China, borne with all the proverbial cheerfulness of its long-suffering people. There are a few well-drawn types, all of the coolie or peasant class; for the authoress obviously did not come into contact with the cultured, or she would not have written that the only conversation of the Chinese is about food and money. The reader not well versed in modern Chinese history would probably like to have been told or reminded that Tuan Fang, casually mentioned as having been slain at Chengtu, was the great Viceroy of Nanking who withstood the Imperial Court so strongly at the time of the Boxer rebellion.

There is an appendix by Mr. Moore-Bennett giving a brief geographical and historical sketch of Yunnan, with an appreciation of the great Wu San-kwei who was so largely responsible for the establishment in the seventeenth century of the now lost Manchu dynasty; but it too adds nothing to what is already well known. The illustrations, from photographs, are the best part of the book.

A. S. E.-S.

L'AFRIQUE SAHARIENNE ET SOUDANAISE: CE QU'EN ONT CONNU LES ANCIENS. Par ANDRÉ BERTHELOT. *Paris: Les Arts et le Livre* 1927. 9×7 *inches;* 432 *pages; maps*

The geographical knowledge of the ancients will always be an intriguing subject. Its wide appeal may be partly due to the scope it gives to the imagination—with little risk of flat contradiction—but principally to the ever-present possibility of new evidence of ancient exploration coming to light. Some still look forward to a Punic inscription from the Guinea coast, or even a Roman monument in the Sudan.

If M. Berthelot's views do not always accord with those of better-known authorities it is not because he has embarked upon his task in a light-hearted manner. His volume represents a great deal of study and research. Its four hundred pages are so crammed with facts and figures that we are half inclined to forgive his omission of an index, though it is sorely needed.

Any study of the ancient geographers must be based upon a thorough knowledge of modern conditions. Although the author devotes a quarter of his volume to a description of Northern Africa in historic times, he shows no great familiarity with his subject. For example, owing to his belief that the principal towns of the Niger basin were also important centres of population in classical times, he is inclined to credit Ptolemy, to whom he devotes a hundred pages, with a more intimate knowledge of the Western Sudan than most are prepared to admit.

The author has exhaustively studied all geographical writings of the classical authors from Homer and Herodotus down to Ptolemy, and the volume merits the attention of any one interested in the subject. Many of the suggestions which he tentatively puts forward are unlikely to find general acceptance, but the book contains some valuable material.

E. W. B.

LES CAMPAGNES COLONIALES BELGES, 1914–1918. VOL. I. (État-Major Général de l'Armée. Section de l'historique.) *Bruxelles: Institut Cartographique Militaire* 1927. 10×6 *inches;* 406 *pages, and maps*

This is the first of three volumes published by the Belgian Government, dealing with the part played by the armed forces of Belgium in Central Africa in collaboration with those of Great Britain and France against the German forces under General von Lettow. This volume deals with the defence of Northern Rhodesia, the subjugation of the German Cameroons, the destruction of the German vessels on Lake Tanganyika, and the defence of the Belgian Congo in the region of Lake Kivu. The events of this minor campaign are dealt with in remarkable detail and commendable impartiality, but the principal interest the volume possesses for us English lies in the series of carefully produced maps, the best we have seen, of the parts of Africa where Belgian troops were engaged. A. G. C.

AN ENGLISHMAN AND THE MEXICAN INQUISITION, 1556–1560. Edited by G. R. G. Conway. *Mexico City, privately printed* 1927. 9×5 *inches;* xxxviii+167 *pages; photographs and facsimiles of manuscripts.* 15*s*

Mr. George Conway, whose bibliographical work and collections bearing on early European visitors to Mexico are well known to more modern travellers, has produced a brochure of great interest. The present volume deals with the experiences and trial before the Inquisition in Mexico of one Robert Tomson, an Englishman who was amongst the first of his race to enter the closely guarded colonies in the New World belonging to Spain, and who was arrested (as the result of a casual conversation), minutely interrogated, sentenced to penance, the wearing of the yellow *san benito* for two years, to the confiscation of all his property, and to a year of imprisonment in Castile. As a consequence of the sentence, Tomson was shipped back to Spain, but when he was released from prison had the luck to marry a lady of wealth, and so to retrieve his fallen fortunes.

The documents which Mr. Conway has so carefully translated and presented display the extreme punctiliousness of Spanish legal procedure in Mexico, as invoked by the Inquisition authorities, and they shed an interesting light on colonial conditions, and especially upon Mexico City in the sixteenth century. The appendix and notes to the volume have been prepared with meticulous scholarship, and there is a good index. L. E. E.

LATIN AMERICA—MEN AND MARKETS. By C. S. Cooper. *Boston: Ginn & Company* 1927. 9×6 *inches;* ix+466 *pages; illustrations and map.* 15*s*

We are told in the preface of this book that the writer's object is to promote a clearer understanding of Latin America from the business man's standpoint. It is natural, therefore, that the human aspect is emphasized, that the possibilities of the various regions as markets should receive special attention, and that geographical detail should fall rather into the background. The whole treatment aims at making an appeal in particular to North American readers, so that the part played by the United States in the history and in the external trade of the Central and South American republics comes in for considerable discussion.

The first chapter, entitled "Understanding Latin Americans," is the best in the book. Here new ground is broken, a sympathetic picture of the people is presented, and points are made which Anglo-Saxons as a whole appear only

too ignorant of. After a short elementary chapter on the historical background, the book then proceeds in the following fifteen chapters to describe the different political divisions in detail, each under such sub-heads as Geography, History, People, Products and Industries. In this main part of his book the writer is at his best in describing the people and their social institutions; geographical features are dealt with in very brief outline, the industries rather more fully, but with what appears rather undue respect for mere facts and figures.

The book will probably serve its special purpose. It constitutes a fairly complete collection of the sort of facts which a business man with little leisure for serious study is likely to require, and the arrangement is such that the information relating to any particular district is easily found even without the assistance of the exhaustive index at the end of the volume. E. W. S.

SIR WALTER RALEIGH. By MILTON WALDMAN. The Golden Hind Series. *London: John Lane Ltd.* 1928. 9×6 *inches;* xiv+255 *pages; illustrations and maps.* 12*s* 6*d*

The Golden Hind Series continues, and with Mr. Milton Waldman's 'Raleigh' reaches a high level of style and historical competence. It is the more gratifying to be able to say so, since the student of Elizabethan history must always open a new life of Raleigh with trepidation, especially if it forms part of a popular series. There is a temptation in such work merely to play for popularity, to forget judgment and probability, and to produce a sentimental romance. Raleigh's career and personality present this temptation more strongly than do most, and some of his past biographers have yielded to it. Mr. Waldman has not. For him Raleigh is an artist and an actor who uses his talents to make his living, and is no more able than the rest of us to exist on great thoughts to the exclusion of daily bread. It was a pity that Raleigh had those gifts, for whilst he never put them to the highest uses they ensnared him into neglecting the more rugged possibilities that lay in his energy, his cool judgment, his powers of study, and his great physical courage. To quote Mr. Waldman:

> "As courtier the best of his talents were bound to lie unutilized, and only the worse part of his character and intelligence brought into constant activity. His appearance, his facile mind, his knack of intrigue, served to obtain him easy substitutes for what he should have earned by his energy and his genius. . . . The result is that he never became the sailor that Drake was, nor a statesman of the stature of Cecil; he remained a courtier, and the cunning Elizabeth, while free with her gifts, took care that he never became more. She admired, perhaps loved, him; but her astute mind was fully aware that he relied too much on his lesser parts, that he had not sufficiently trained himself for more serious service."

Drake, in fact, appealed to the virile sovereign, and Raleigh to the very feminine woman, who were united in the strange personality of Elizabeth. The distinction has held through the centuries, and it is fairly safe to say that the average man of to-day, asked to name the greatest Elizabethan man of action, would say Drake, whilst the average woman would choose Raleigh.

Having defined his subject, Mr. Waldman treats him with sympathy and realism and makes the reader feel that he is in the hands of a historian whose judgment he can trust. The account of the trial of 1604 and that of the last scene in 1618—to mention two prominent passages—are written with a restraint which allows the facts to make their own appeal unclouded by modern rhetoric. Judgment must be founded on knowledge of facts, and the events and documents of Raleigh's career have been conscientiously studied in the writing of this

book. There are probably a few awaiting excavation—papers dealing with the minor activities of Raleigh and his brother certainly exist among the records of the High Court of Admiralty—but any new discoveries are not likely to be revolutionary, save perhaps for the years 1616–17. Mr. Waldman has made a thorough survey of the printed and much of the manuscript material, although if he had gone behind the very inadequate 'Calendar of Domestic State Papers' to the documents listed in it he would have gleaned more about one or two of the earlier transactions, notably the voyage of 1578. For the later years the Venezuela Blue Books and the 'Venetian Calendars' give information that has become available only during the last generation, and this has been duly noted. If not minutely exhaustive in research, the author displays a merit which the state-paper historian often lacks: he has digested the work of his predecessors and makes full acknowledgment of it.

On one or two points the reviewer must disagree with Mr. Waldman. The 'History of the World' is quoted as evidence for Raleigh's claim to have been present at Jarnac and Moncontour in 1569. Raleigh discusses those battles, but surely does not specifically state that he was there in person, and the probability is rather that he was a member of Henry Champernowne's troop of Devon horse, which joined Coligny just after Moncontour and witnessed only the flight of the Huguenot army. Next, concerning Raleigh's faith in the Guiana gold-mine. He was very insistent upon it after his imprisonment had begun, but was he really so convinced before that date? Mr. Waldman does not explain why, granted that overmastering belief, Raleigh did not contrive to go out to Guiana in 1598–1602, for his employments during those years were not such as to prevent him if he had been determined. For his knowledge of naval affairs the author accepts Raleigh at his own valuation without reference to the contrary opinion of Mr. Oppenheim, who says roundly, "Most of Raleigh's observations on maritime matters, where not doubtful or unintelligible, can be shown to be incorrect" ('Administration of the Royal Navy,' p. 66; for details see also p. 127). Finally, there is no mention of Raleigh's connection with Guiana voyages made during the term of his imprisonment. Their details would serve to clear up some obscurities in the final tragedy. To Sir Thomas Roe's expedition of 1610–11, for example, he subscribed £600, and so presumably was informed of its results, and Roe reported that the Spaniards were strengthening their occupation of the Orinoco and "raising a new city," which seems to point to the shifting of San Thomé to the position in which the expedition of 1618 found it.

These suggestions are put forward with a view to future editions of what should prove a permanently useful book, and they are matters of opinion rather than of fact. They must not be taken to imply that the reviewer has anything but respect and congratulation to offer to Mr. Waldman on his achievement.

J. A. WILLIAMSON.

THE RACES OF MANKIND. By H. J. FLEURE. Benn's Sixpenny Library, No. 113. *London: Ernest Benn Ltd.* 1927. 6×4 *inches;* 80 *pages.* 6*d*

THE MAKING OF MAN. By R. R. MARETT. Benn's Sixpenny Library, No. 114. *London: Ernest Benn Ltd.* 1927. 6×4 *inches;* 78 *pages.* 6*d*

The first of these two booklets contains so much speculation and surmise that it is to be feared the general reader for whom the "Sixpenny Library" is intended will have some difficulty in following and appreciating it. The author's idea of what he calls the drifts of mankind, dispersed from an original

home in the Sahara region before it became a desert, is distinctly speculative, and it seems hardly fortunate to base the main argument of such an elementary work on a speculation. It is a pity, too, Prof. Fleure did not give some preliminary explanations, and at least indicate the classifications of Man that ethnologists have adopted or favoured. Whilst the many references to discoveries, types, and ethnological theories will probably be stumbling-blocks to readers previously unacquainted with the subject, they will be interesting to those who have some knowledge of Ethnology and even to the expert.

Dr. Marett's brochure is commendable for its clearness and definiteness. He explains in simple and lucid language the foundations of what is often called Social Anthropology, which will be easily followed and understood by any intelligent reader. Evolution, Magic, and Religion in relation to primitive man are explained and happily illustrated, and the origin of Marriage, Government, Law, Culture, and Morality discussed. As a stimulant to thought, a broadening of outlook, and in showing the true significance of Evolution this little work cannot but serve a most useful purpose, and it is to be hoped it will be widely read and deeply pondered. There are two or three curious little mistakes, as, *e.g.*, the statements that a row of clay bears was found in a Pyrenean cave, and that a well-designed club of elephant bone was found near the Piltdown skull. Some have refused to recognize this much-discussed object as of human manufacture at all. E. A. P.

MAPPAE ARABICAE—ARABISCHE WELT- UND LÄNDERKARTEN des 9–13. Jahrhunderts: mit einleitenden Texten herausgegeben von KONRAD MILLER. Band I (5 parts), Band II (2 parts), Band III (2 parts), and Band VI (plates only). *Stuttgart: Selbstverlag des Herausgebers* 1926–27. 12×9 *inches*

This remarkable work is to be completed in six volumes. Of the parts before us, vol. I contains a general preface followed by a comprehensive and interesting survey of the history of Arabian cartography. With this section we are given 4 plates of reproductions of 12 Arabian maps of the Mediterranean from originals in various libraries in Europe, with transcripts in Roman characters. Then, after an introductory memoir, we have 6 sheets reproducing in congregated form, with the names in Roman characters, the 70 sections of Idrisi's larger world map of 1154 A.D., after the original Arabic MSS. in different libraries, with an extra sheet reproducing similarly 10 sections of the 3rd Climate from the Greaves MS. in the Bodleian Library. Part 3 contains a detailed description of the smaller Idrisi map of 1192 A.D., with a congregated transcript of its 70 sections. Vol. II deals with the Arabian maps of Europe and Northern Africa, with a supplement containing reproductions of 23 maps of the Islam-Atlas from original MSS., besides numerous illustrations in the text. In vol. III the author begins a detailed description of the large Idrisi map, country by country, this volume dealing with Western and Southern Asia. It is accompanied by reproductions of the relevant sections of the Islam Atlas, faced in each case by hand drawings interpreting each section in Roman script. Interspersed with the text there are also outline modern maps embodying Edrisi's data, and a certain number of sketches of sections of his smaller map given for the purpose of comparison with the larger. Vol. VI is a portfolio of 80 plates of photographic reproductions of all the sections (70) of Idrisi's world-map of 1154 from the MSS. in Paris, Oxford, Cairo and St. Petersburg, and of his smaller map of 1192 from the Constantinople Codex 688 (library of Hakim Oghlu Ali Pasha).

The more one studies these reproductions and the descriptive text, the more

one appreciates the stupendous nature of the task which Dr. Miller has set himself. The labour, for example, of collating the 73 maps in the Constantinople Codex No. 688, reducing them to the same scale, omitting overlapping or repeated portions, and fitting them together for reproduction as a whole, must alone have been enormous, and enough to tax sorely the patience of even so enthusiastic a worker. The publication of these maps in complete form for the first time makes it possible to gain a more correct idea of the standard attained by the Arab cartographers up to the end of the twelfth century, and will help to correct several errors in accounts hitherto published of Idrisi's geographical work.

The MS. No. 2221 in the Bibliothèque Nationale, Paris, has long been recognized as the most valuable extant copy of Idrisi's work. Dr. Miller goes so far as to say that it is not improbable that we have in it an original by Idrisi's own hand, very finely executed and drawn and coloured with the greatest care, perhaps intended for King Roger himself. The trouble is that it is not always quite legible ; some sheets are badly worn or otherwise damaged, and one whole sheet and half another are missing. The editor has generally based his edition of the 1154 map upon this MS. ; but it is clear that he has often utilized the other MSS. in the preparation of his congregated key map. As a rule the Oxford MSS. are clearer ; but, as Dr. Miller points out, O_1 bears evidence of very hasty preparation, and the drawing is very rough, while O_2 obviously consists of a new edition, and is so " independent " in places that it might almost be the work of another geographer. At first sight one is struck, when studying these reproductions, not only by the variations in detail between the several MSS. of the 1154 map, but also by the wide differences in certain areas between the 1154 map and the 1192 map. We must, of course, recollect that in those days all reproduction or copying had to be done by hand ; but this will not account for such divergency as is found, for instance, in the presentation of Northern Europe and of the upper Nile with its two great branches.

As Dr. Miller has very clearly demonstrated, there has been a tendency in the past rather to exaggerate the influence of Ptolemy's cartography upon Idrisi. It seems probable that this influence was chiefly confined to Ptolemy's world-map, and possibly also to Arabic translations from his Greek text. Idrisi cites Ptolemy four times ; he also adopts the same arrangement of seven climates, but in detail these are scarcely reconcilable. Where Idrisi has noted " ruined " (*kharāb*) against the names of places, it may be assumed, as Markwart has pointed out, that the names were taken from Ptolemy. But, as Dr. Miller notes, where there is an apparent similarity between Ptolemy and Idrisi, an even greater disparity will be discovered on closer examination. It has been thought that Idrisi based his representation of the course of the Nile upon Ptolemy, but if the maps be carefully scrutinized the dissimilarity is manifest, and the remarkable accuracy of Ptolemy's delineation of this river the more striking. Again, while Idrisi follows Ptolemy in extending the east coast of Africa almost due eastward (instead of southward) across the Indian Ocean, he does not join it on to the south-east corner of China, as Ptolemy does, but leaves a wide gap studded with islands (the eastern archipelago). His whole delineation of the south coast of Asia and Malaysia, in fact, differs widely from that of Ptolemy, most noticeable perhaps being the omission of any indication of the Malay peninsula, which is shown in even exaggerated dimensions by Ptolemy. As we proceed eastwards from the Straits of Babelmandeb Idrisi's map becomes increasingly difficult to follow, till we reach the Malay Archipelago, where confusion is worse confounded. Zanj (the northern

portion of the east coast of Africa) and Sofala (the part facing Madagascar) are shown as lying opposite the west coast of India and Ceylon, respectively; while the country of the Waq-waq and the archipelago known by that name are placed to the south of Cambodia, Annam and China! It is also clear from his text (so far as we know it at present) that he has, as M. Gabriel Ferrand has already shown, confounded in a quite inexplicable manner the islands of Zanj, which he marks on his 1154 map as lying near the coast of Zanj (north-east coast of Africa) with Java and Sumatra and neighbouring islands. This inaccuracy is the more surprising when we refer to the numerous descriptions of the coasts of Southern and South-Eastern Asia written before Idrisi's time, to some of which he refers. As an instance, take the undoubtedly authentic and important description (recorded in A.D. 851) by the merchant Sulaiman of his voyage from the Persian Gulf *via* Quilon, Palk Strait, the Nicobars and the Straits of Malacca to Canton in China. This work is not mentioned by Idrisi, and was apparently not utilized by him. Besides this traveller, there were many other Arab writers who had given accounts of these parts, which should have helped towards a better representation on the map. Even Masudi who is often cited by Idrisi, does not seem to have been fully utilized.

Having regard to the vast labour expended upon this work and the well-known difficulty of transcribing names from Arabic script, it may appear ungenerous to be critical as to details, especially in a first edition, but criticism will inevitably be directed to mistakes and to occasional want of uniformity in method (*e.g.* the use sometimes of *u* and sometimes of *w* for the same Arabic letter) in transliteration. When a new edition is prepared special attention should be paid to revision of the Roman transliteration, though we fully sympathize with Dr. Miller in the remarks he has made on this subject in his introduction. It may be added that small skeleton key maps might with advantage be inserted in vol. VI, showing the numbers of the plates on which the photographic reproductions of the various sections are to be found. Such small key maps could be prepared by photographing down the congregated maps and entering plate numbers in, say, red ink. The next desideratum is a reliable translation of Idrisi's text. We have none in English (complete), and have to fall back upon Jaubert's French translation, which was made about ninety years ago and is inadequate to present-day requirements. Later on perhaps we may hope to have a complete index to all place-names in Idrisi, with references to the sections on the maps and in his text where they are to be found, with the modern names given in all cases where they are identifiable.

Students of the history of geographical knowledge must ever be grateful to Dr. Miller for his inception of this troublesome task. He has rendered a memorable service to the science of geography, but he has also placed the Islamic world under an obligation by restoring to light the work of their great cartographer which lay hidden from all but a few scholars among the archives of widely separated libraries. C. E. A. W. O.

E. VON SEYDLITZ'SCHE GEOGRAPHIE. Hundertjahr-Ausgabe. Dritter Band. Aussereuropäische Erdteile. Herausgegeben von K. KRAUSE und R. REINHARD. *Breslau: Ferdinand Hirt* 1927. 10×7 *inches;* xii+766 *pages; maps, diagrams, and illustrations. M.*32

This handsome book makes us wish that we had something of the sort—with comparatively slight alterations of proportion and outlook—in this country. To judge from the third volume now before us, an English equivalent of the complete work would meet the crying need for a text-book which could con-

fidently be recommended as covering any reasonable syllabus for pass degrees, though the total cost might be somewhat formidable for the individual student. At least, even as it stands in German, is should be in every college reference library.

There is, of course, more space allotted to former German colonies and spheres of influence than we should give to them, but happily there is no futile labouring of grievances, strong as is the sentiment to be read between the lines. In general the political references arise naturally from broad geographical foundations, and the conclusions drawn are in the main just and not provocative to an English reader. As a typical case we may take the discussion of British rule in India on p. 84. M. K. Gandhi is cited to describe as "erstaunlich und erniedrigend" the subjugation of some 300 millions of the native population by 100,000 white men, and the expression "Blutbad von Amritsar," on the face of it, conveys an imputation of unnecessary harshness in a matter about which there may at least be more than one opinion. On the other hand, there is a generous testimony to the material blessings afforded by strong government and a recognition of the difficulties with which that government has to cope.

The editors' task has been well done, and inequality of treatment as between the various sections by different authors is less conspicuous than is often the case in a compendium. The choice and annotation of some 400 photographic illustrations, which, with the exception of the rather unnecessary coloured plates, are of the highest technical excellence, leave little to be desired. The sketch-maps and diagrams scattered profusely throughout the book add much to its educative interest. It would have been better, we think, to have distributed the photographs, and it would hardly have added much to the already considerable costs of production to have brought the system of symbols employed in the sketch-maps into better harmony. Copper is represented on the two maps of p. 45 by a lozenge and a square respectively, on p. 124 by a cross, and on p. 487 by a triangle. The ascription to original sources has been done more conscientiously than intelligently in the case of the block-diagram on p. 441—"nach Birdseye and Moore"! But slips such as this are few and far between. We shall look eagerly for the remaining volumes of this work. A. J. P.

GRUNDZÜGE DER ALLGEMEINEN WIRTSCHAFTSGEOGRAPHIE. Von B. DIETRICH. (Sammlung Borntraeger, Bd. 13.) *Berlin: Borntraeger* 1927. 9×5¾ *inches;* 233 *pages;* 10 *maps. M.*8.70

This introduction to commercial geography collects together a wide range of information in an efficient yet uninspiring manner. One of the five chapters—a very short one, it is true—is devoted to the importance of maps and diagrams, but the ten rather unsuccessful maps given by the author scarcely inspire confidence in graphical methods. L. D. S.

THE MONTHLY RECORD

MEDALS AND AWARDS, 1928

His Majesty the King has approved the award of the Royal Medals as follows: *The Founder's Medal* to Dr. T. G. Longstaff for his discovery of the Siachen Glacier and long-continued geographical work in the Himalaya; the *Patron's Medal* to Captain G. H. Wilkins for his many years' systematic work in Polar Regions, culminating in his remarkable flight from Point Barrow to Spitsbergen. The Council have awarded the *Murchison Grant* to

Captain C. J. Morris, I.A., for his recent journey in Hunza; the *Back Grant* to Mr. George Binney for his journey across North-East Land and his successful conduct of the Oxford Expeditions to Spitsbergen; the *Cuthbert Peek Grant* to Mr. H. G. Watkins in recognition of his leadership of the Cambridge Expedition to Edge Island and to assist him in his proposed expedition to Labrador; and the *Gill Memorial* to Mr. C. P. Skrine for his exploration of the Qungur area and his work on Chinese Central Asia.

THE EARTHQUAKES IN BULGARIA AND GREECE

On the south of the Balkan Peninsula, especially in the Ionian Islands, in most of Greece, and near Constantinople, destructive earthquakes are very frequent, more frequent indeed than in any other part of Europe. Bulgaria, on the contrary, is almost free from strong shocks. Only three are mentioned by Milne in his catalogue of destructive earthquakes. One, in 1750, was strong enough to throw down houses in Plovdiv (Philippopolis), and two others of less strength were felt in Rumelia in 1759 and 1886. In the country as a whole, earthquakes are apparently less frequent than they are in Great Britain. Thus, like the Charleston earthquake of 1886, the first great shock on April 14 last visited a district in which earthquakes are almost unknown. It occurred at 11 a.m., and its epicentre seems to have been near Chirpan and Borisovgrade, both of which were almost entirely destroyed. The area of damage must have been about 70 miles long, extending from Harmanli on the east to beyond Plovdiv on the west. The second principal shock, distinctly stronger than the other, occurred on April 18 at 9.20 p.m. In this, the origin was displaced a dozen miles to the west, to the neighbourhood of Papazli, near enough to Plovdiv to cause considerable damage there. In this city more than 1800 houses entirely collapsed and 6000 were rendered uninhabitable. Many of the large modern buildings were thrown down, except in the central part, where the large shops and hotels are situated. Here the intensity of the shock was less, owing to the rocky nature of the ground. Eight villages near Plovdiv were entirely destroyed. After-shocks of less strength, but bringing down houses already damaged, occurred in various parts of the meizoseismal area until April 27. According to the official reports, 103 persons were killed and 700 wounded during the earthquakes; the total value of the property destroyed is estimated at £3,700,000. The comparatively small loss of life is no doubt due to the times at which the principal shocks occurred.

On April 22, only four days after the second of the great Bulgarian earthquakes, Corinth, situated in one of the most active seismic zones in Europe, was almost ruined by a violent shock at 9.45 p.m. Most of the houses in the town collapsed, those not thrown down being left for the most part uninhabitable. Many of the coast villages to the west of Corinth were practically destroyed. The earthquake was, as usual, followed by many after-shocks, several of them strong enough to cause fresh damage, especially one on April 25 at Isthmia, 4 miles east of Corinth, and another on April 29 at Kiato, about 8 miles to the west. The Corinthian earthquakes thus differed from those in Bulgaria in their much smaller area of destruction and in the narrower limits of their focal migrations. C. D.

THE MONDSEE IN THE SALZKAMMERGUT

A new bathymetric survey of this lake has lately been carried out by Dr. J. Müllner of Innsbruck, who records the results (in text and map) in *Petermanns Mitteilungen*, 1927, Heft 11/12. Until 1909 the under-water contours of the lake were known only from the limited number of soundings made by F. Simony,

recorded in the Atlas of the Austrian Alpine lakes, and the seiche observations made by Endrös in 1906 gave a period considerably shorter than that arrived at theoretically on the basis of Simony's work, leading to the belief that the deepest part had not been found. In 1909 Halbfass sounded the region of the deepest part afresh, confirming Simony's results. After further calculations Endrös concluded that the abnormally short period of the seiche established by him must be due to some special character of the basin, such as its long narrow termination eastward. But there still seemed a possibility that further depths existed in the western part, as suggested by the position of the node of the seiche 1 km. on this side of the deepest point hitherto found: Dr. Müllner therefore decided to undertake further soundings, bringing the total number up to 330. The result was to confirm the previous results, so that the map now compiled from the work of the three observers (which brings out very clearly the cauldron-like form of the basin) may be trusted to give a correct view of the facts. The abnormality of the seiche is thought by Dr. Müllner to be perhaps accounted for by the broad opening of the valley of the Wangau Ache, which seems to have an important influence on the prevailing winds.

THE BIRDS OF TUNISIA

With a view to supplementing a somewhat poor collection of bird-skins from Northern Africa in the Natural History Museum, Mr. Willoughby P. Lowe, accompanied by Mr. David A. Bannerman, paid a three months' visit to Tunisia early in 1925. Tunisia was chosen because it was a much easier country to work than either Morocco or Tripoli, whilst Algeria's bird-life was already well represented in Lord Rothschild's Museum at Tring. The results are described by Mr. Bannerman in *The Ibis* for March 1927, a reprint of which has been received from the author. The paper is divided into a narrative, with excellent photographs, of the journey through the Regency (this part is full of interest from the point of view of general geography), and a categorical description of the many species of birds met with. The author speaks highly of the efforts of the French authorities to render the expedition a complete success. Tunisia consists of (1) a forested area in the north with splendid forests of cork-oak and evergreen-oak; (2) a richly cultivated area north of the main diagonal mountain range (Tunisian Atlas), in which olive plantations teeming with bird-life figure prominently; (3) the maritime plains of the Sahel; (4) plains and steppes with much Aleppo Pine and *Maquis*; (5) a semi-desert tract north of Zerid; and (6) a full desert tract south of the same. The wilder mountain regions harbour, as might be expected, many species representative of the larger birds of prey—eagles, buzzards, falcons, etc.—whilst the cultivated areas attract linnets, finches, sparrows, starlings, doves, and others. In the southern areas there is a change to a desert avi-fauna, including the black-bellied sand grouse, desert wheatear and bifasciated lark, among many other specially adapted races. It is a striking fact that nearly all our familiar English birds are well represented in Tunisia, either in the species, a sub-species or a local race, though it is curious that there should be no reference either under the English or Latin names to the nightingale, even on the score of absence. Some definite and much-needed information is yielded respecting migratory movements. Swallows and martins find it too cold to winter on the coast of Tunisia, except in quite isolated cases, whereas some individuals during the great northward migration in spring stop to breed there. It seems, therefore, that whereas (as has been definitely proved by the marking of individuals) some individual swallows have the wide range between South Africa in winter and the British Isles in summer, others pass no farther south

than the Sudan in winter and no farther north than the Mediterranean countries in summer. Within the narrower range the seasonal phenomena would thus naturally be less definite and more likely to admit of anomalous cases, so that whilst a small percentage of swallows might winter in Tunisia or Sicily against the general rule, none ever do in England. In the picturesque Roman ruins of the country blue rock thrushes, rock doves and kestrels abide, and the great limestone mass of Jebel Ressas, rising 2600 feet sheer out of the plain about 20 miles south-west of Tunis, was at one time the haunt of the various kinds of vulture.

Frequent mention is made in the narrative of the bleakness of the weather and lateness of the spring on the high plateau where the birds in March seemed not to have even thought of nesting. Thus on the evening of March 16, as the party were arriving at the village of Sakit Sidi Yussef (about 2500 feet), near the Algerian frontier, snow began to fall. It was covering the ground next morning, and fell in a "regular blizzard" all next day, rendering the work of collecting specimens in the neighbouring forests very trying. This is interesting as showing that the March snowfalls, born of the Arctic ice which frequently enough affect sea-level districts in England, can occur so late in the season down to 2000 feet as far south as Northern Africa. On referring to charts we find that on the morning of 17 March 1925 the air temperature along the coasts of Algeria and Tunisia was about 45° F. Assuming the ordinary rate of decrease of temperature with height this would bring the temperature in the free air above the coast of Tunisia down to about 36°, and as it is quite likely that the rocky plateau surface would at a date still on the winter side of the equinox be cold enough to chill the air in contact with it another degree or two, we infer (in default of direct evidence) a temperature of about 34° for the Tunisian plateau on the day in question—a very suitable level for a heavy fall of moist snow.

TASMANIAN TEKTITE—DARWIN GLASS

In various parts of the globe small vitreous bodies, whose origin is still something of a mystery, occur under the names of Moldavites in the Moldau River area, Billitonites in the Dutch East Indies, Australites in Australia, Sclonite in Scandinavia, and Darwin Glass in Tasmania. The last is a remarkable variety and forms the subject of a joint paper by Sir T. W. Edgeworth David, H. S. Summers, and G. A. Ampt in the *Proceedings of the Royal Society of Victoria* (vol 39, pt. II, 1927).

Darwin Glass occurs chiefly on the spurs of Mount Darwin near the west coast, but nowhere above about 1300 feet on the mountain, whose summit rises to 3340 feet; the geological evidence goes to show that the age of the glass is contemporaneous with the Pleistocene glaciation, which was very severe in Tasmania. After an account of the physical and chemical characters of the glassy bodies the authors go on to correlate the Tasmanian with the other tektites and show that they are all genetically related to one another. Particularly interesting is a map which reveals the fact that all the tektites recorded occur in the Eastern Hemisphere either along or close to the same Great Circle passing through Tasmania, Australia, the Dutch East Indies, Central Asia, Central Europe and Southern England. Hence further search would be profitable in areas traversed or nearly traversed by this circle. The authors finally consider the various hypotheses as to the origin of the bodies, whether artificial, volcanic, fulguritic, or meteoritic, and by a process of elimination reach the conclusion that they are of meteorite origin, although at present there is no positive evidence in support of the hypothesis.

CAPTAIN WILKINS' POLAR FLIGHT

By a dramatic coincidence the news of Captain Wilkins' successful flight from Point Barrow to Spitsbergen was published in London on the morning of the day when the Council of the Society met to decide on their recommendations to His Majesty for the award of the Royal Medals: and four days later the King approved the Council's recommendation that Captain Wilkins should receive the Patron's Medal—not for the flight as an isolated exploit, so much as for the long years of effort in polar exploration with this brilliant climax. Four years in the Canadian Arctic with Stefansson: two years flying with the Australian Flying Corps during the war; a couple of adventures in the Antarctic; and three seasons Arctic flying at Point Barrow were the long, strenuous apprenticeship that prepared his sudden triumph; while three years of air mail work in Alaska preceded Lieut. Eielson's long co-operation with Captain Wilkins. We had in the *Journal* some months ago a summary of their adventures in 1926 and 1927, and should have been prepared for what was to most a brilliant surprise, for their plans of this season had been little advertised.

Four long reports in the *Times* of April 23, 25, 26, and 27 make it unnecessary for the moment to give more than a brief summary of the flight. We look forward to hearing both navigator and pilot at the Anniversary Dinner on June 18, and hope to persuade them afterwards to publish in the *Journal* a full account of their technique of polar air navigation which brought them safe through in conditions which towards the end were as bad as they could be. After a week's delay and minor accidents in starting their heavily loaded machine they got off and set their course, not across the pole, but rather coastwise to pass over as much totally unexplored ocean as possible. They saw no new land, and had unfortunately cloud and fog over the most critical part of their course. They had provided themselves with gear for echo sounding, but in the conditions could not risk a landing until the most desired locality for sounding was long past. They sighted the mountains of Grant Land and Northern Greenland, wreathed in storm clouds, and approached their goal in a furious snowstorm which limited visibility to a few yards. It was an ill return of nature for twenty hours of skilled navigation; but the pilot with fine judgment landed so neatly in the blinding snow on Dead Man's Island, that after being snowed up in their machine for five days, they rose serenely and flew across to Green Harbour, only twenty miles away, whence the radio station transmitted the long, modest, informing, and thoughtful messages that are in their way as remarkable as any part of the exploit.

From these messages we learn that Captain Wilkins navigated with a boat compass and a bubble sextant, on charts prepared in advance by the American Geographical Society, doubtless on the lines of those made for Commander Byrd, of which some account has been given in the *Journal*. We should like to publish these observations and graphical reductions in detail, for nothing exhibits more clearly the remarkable combination of nerve, judgment, and scientific skill which brings so hazardous an exploit to so happy and fortunate an end.

WILD-LIFE PROTECTION

We have received from the Society for the Preservation of the Fauna of the Empire a small pamphlet issued by them under the title 'The Passing of Wild Life.' In many parts of the world, wild life is being destroyed at a greater rate than it can reproduce itself. This is the result not only of the ravages of

sportsmen and traders, but also of the spread of settlement, involving the clearing of forests and the draining of swamps. Farmers and settlers cannot be expected to place the preservation of the fauna before the security of their own livelihood, but it is urged that the formation of National Parks and the appointment of game wardens would not conflict with the interests either of the farmer or of the true sportsman. It is also necessary to control effectively the trade in furs and plumage: so long as the skins of animals protected in their own homes can be sold with ease in other countries, the supply will be maintained. The sea-otter is now so rare that it is protected internationally by an Order in Council under the Seal Fisheries Act, yet skins were sold in London last year. National Parks, if established before it is too late, may well become in time centres of attraction to visitors and sources of patriotic pride, apart from their scientific value. From this latter point of view, "the animals now threatened with extinction are of widely different types: so long as they can be preserved in their natural surroundings they are potential sources of immense importance to us, and those who come after us." Zoological collections alone cannot meet this demand, for they depend for the maintenance of their stocks upon the wild beasts. It is of vital importance to arouse public opinion to the necessity of immediate action, and the Society is anxious to enlist the help of all those interested: it has correspondents in the Dominions and colonies, and is in touch with similar societies. In its own words, "it is not composed of fanatics, but is directed by reasonable people who realize the conditions produced by the opening up of new lands, but at the same time press without ceasing the importance of the creation of adequate sanctuaries before it is too late." Particulars of membership may be obtained from the Acting Secretary, Mr. C. W. Hobley, c/o The Zoological Society of London, Regent's Park, N.W.8.

MEETINGS: SESSION 1927–28

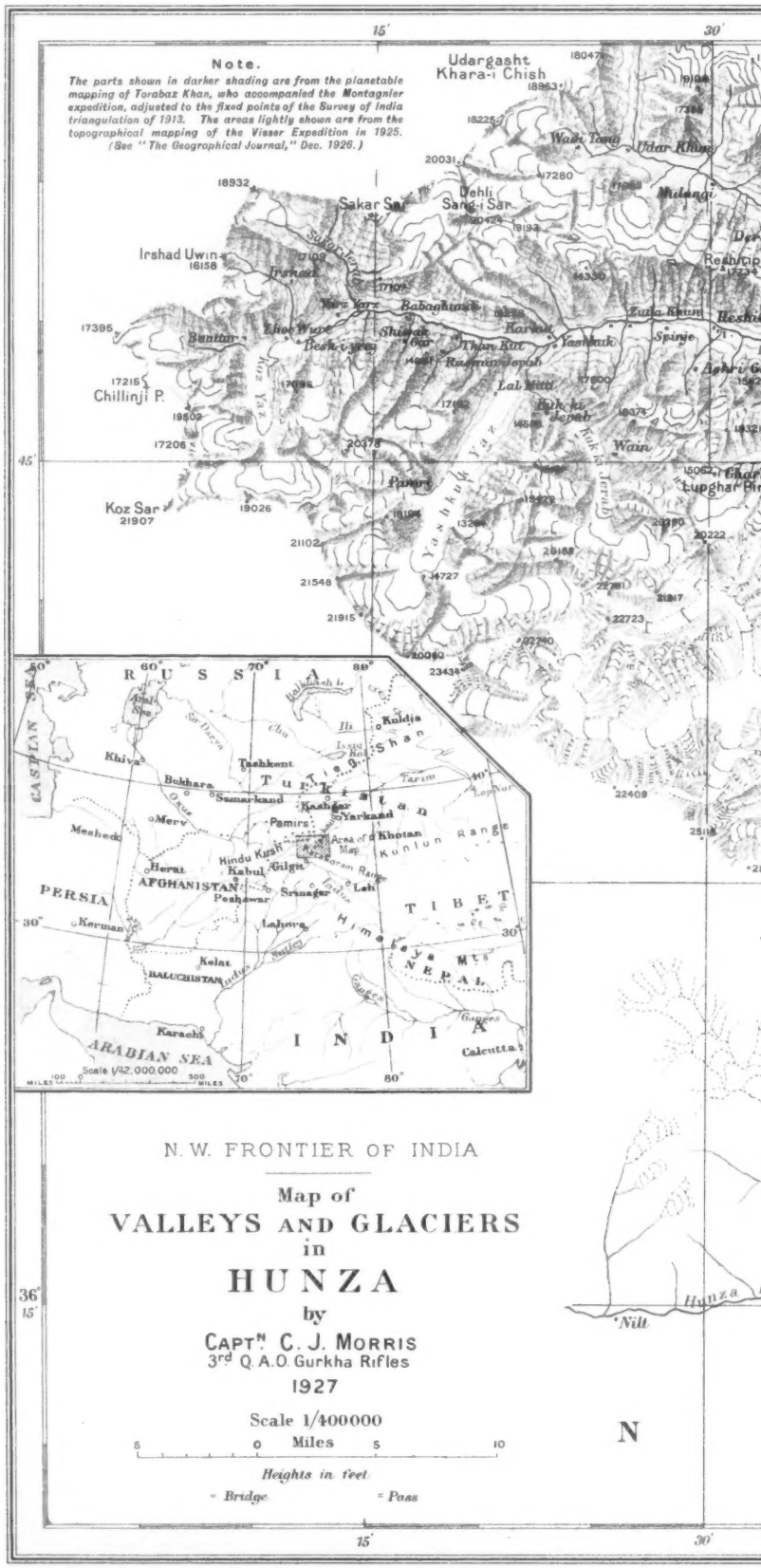
Thirteenth Evening Meeting, 7 May 1928. Sir Charles Close, President, in the Chair

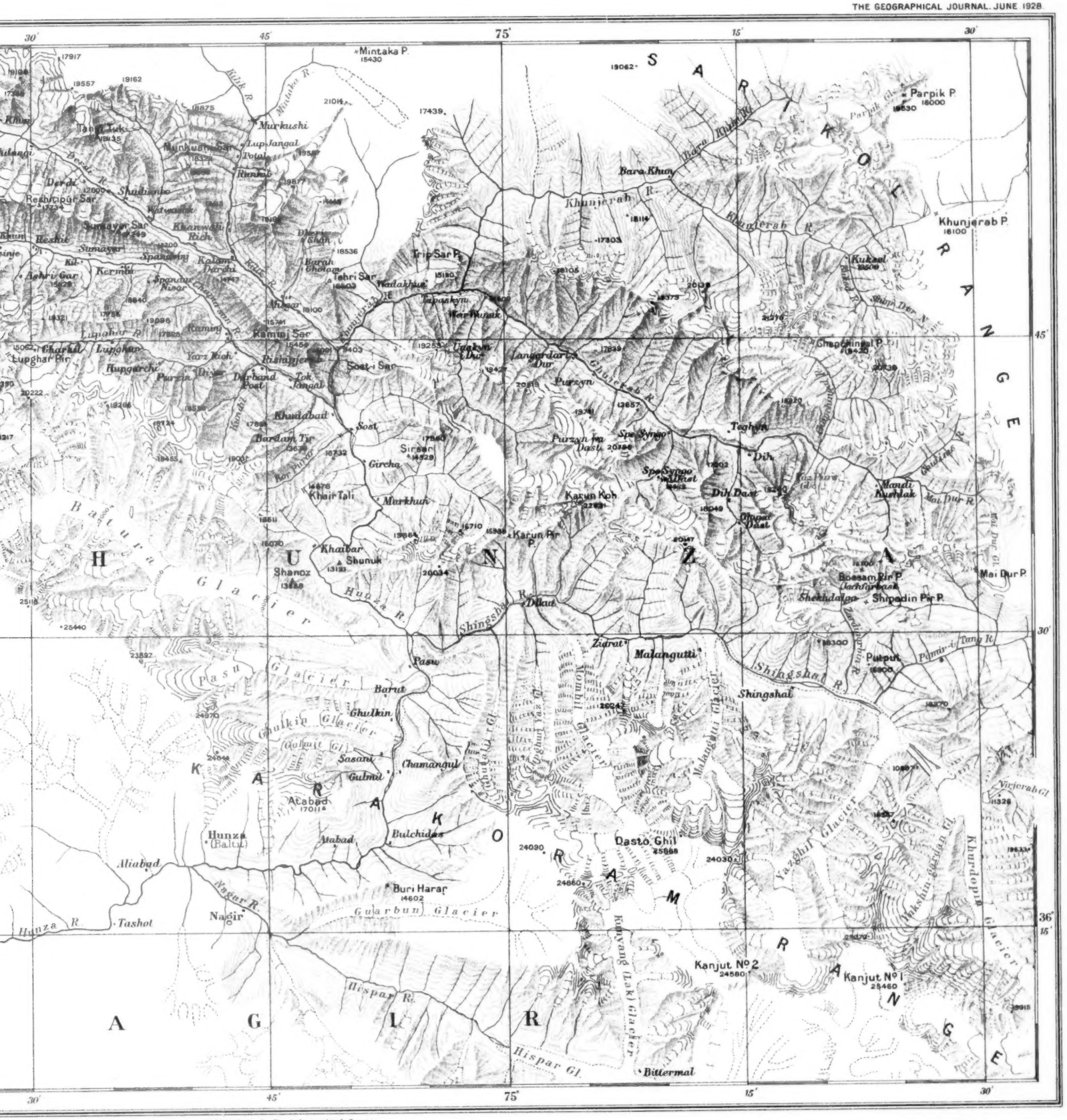
Elections: The Rev. Henry E. Anderson; Claude Hale Birdseye, A.B.; Miss Maude Bowman; Prof. L. M. Gould; the Rev. James Gordon Hayes, M.A.; Giles Greville Healey; Mrs. Frances Carpenter Huntington; Lieut. Alexander Thomas McLeod Mitchell-Innes; Thomas Newby; Paras Main Pradham; the Rev. Rupert C. Thomas; Miss Irene Van Raalte; Miss L. Mabel Warren; the Rev. Clifford S. Weaver, B.A.; Miss Mary Lena Wilson

Paper: The Jubaland Boundary. By Lt.-Col. L. N. F. I. King and Capt. E. H. M. Clifford

Seventh Afternoon Meeting, 14 May 1928. Sir Charles Close, President, in the Chair

Paper: Notes on early geographical instruments. By Col. Sir Henry Lyons, Miss E. G. R. Taylor, and Dr. R. T. Gunther


Note.
The parts shown in darker shading are from the planetable mapping of Torabaz Khan, who accompanied the Montagnier expedition, adjusted to the fixed points of the Survey of India triangulation of 1913. The areas lightly shown are from the topographical mapping of the Visser Expedition in 1925. (See "The Geographical Journal," Dec. 1926.)
Udargasht Khara-i Chish
Sakar Sar
Dehli Sang-i Sar
Irshad Uwin
Chillinji P.
Koz Sar
Pamirs
Wain
Lal Mitti
Baba Ghundi
Shimshal
Yashbuk
Spinje
Mulungutti
Hispar
Lupghar
Nilt
Hunza
15'
30'
45'
36°
RUSSIA
CASPIAN SEA
ARAL SEA
Khiva
Bukhara
Samarkand
Kashgar
Yarkand
Merv
Meshed
Herat
Kabul
Gilgit
Srinagar
Peshawar
Leh
Lahore
Kelat
BALUCHISTAN
Karachi
ARABIAN SEA
PERSIA
AFGHANISTAN
TIBET
NEPAL
INDIA
Kuldja
Tashkent
Tarim
Khotan
Kunlun Range
Karakoram Range
Himalaya Mts.
Calcutta
Scale 1/42,000,000
N.W. FRONTIER OF INDIA
Map of
VALLEYS AND GLACIERS
in
HUNZA
by
CAPTN C. J. MORRIS
3rd Q.A.O. Gurkha Rifles
1927
Scale 1/400000
5 0 Miles 5 10
Heights in feet
= Bridge = Pass
N



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